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CONTENTS.

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TWO TRIASSIC BRYOPHYTES FROM SOUTH AFRICA

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(With Plate I)

ABSTRACT

Two bryophytes from the Molteno Series in Natal are considered. The first, *Hepaticites cyathodoides* sp. nov., is a thalloid liverwort, known sterile only, but showing a close resemblance in thallus structure to the living genus *Cyathodium*. The second, *Muscites guescelini* sp. nov., proves to be a moss; one of the very few mosses from pre-Tertiary rocks. Though sterile *M. guescelini* shows enough detail for a comparison with the Leucodontaceae to be suggested. Some general discussion is offered, with particular reference to the possibility that some sterile fossils may be related to living genera, and to the methods of leaf segmentation in the Bryophyta.

INTRODUCTION

Fossil bryophytes are not common at any geological horizon, and from those Triassic floras characterised by an abundance of the forking leaves of *Dicroidium* only two fossils that may be bryophytes have been recorded. There are only two major records of mosses from pre-Tertiary rocks.

Though both species described here are sterile, enough information is available to allow of close comparison with the gametophytes of living forms. The structures affording this information are readily demonstrated

by means of the balsam transfer technique. This technique, as the works of Walton, Harris and Lundblad show, has proved essential for critical work on fossil bryophytes.

The material, except for one specimen, comes from the Waterfall locality, Burnera, in Upper Umkomaas, Natal. This locality almost certainly falls within the Molteno Series, and so is of Middle Triassic age (see Haughton 1954, Townrow 1957); but the Molteno in Natal is attenuated and the exact horizon of the Waterfall locality is uncertain.

All Type and figured specimens are contained in the collections of the South African Museum, Cape Town.

HEPATICEAE

Hepaticites cyathodoides

Liverworts are delicate organisms, and even when, like the present specimens, they are very well preserved as fossils, often show some features only obscurely. I have therefore made two basic assumptions. The first is that the thallus was not originally more complicated than it now appears to be. The second is that the darker lines seen on the wing (lamina) of the thallus represent a system of partitions within the thallus separating air chambers. For shortness I propose to refer to these air chamber partitions as *internal ribs.*

The internal ribs show more than two cell layers in them, but the thallus wing elsewhere shows two only. Had there been more than two cell layers in the thallus, or other complicating structure, it seems highly probable that traces would have remained; just as more than two cell layers are visible in the internal ribs.

The evidence that the internal ribs are partitions is examined in what follows and their nature is a fundamental point in the comparison of the present material. In order to facilitate such comparisons, I have examined herbarium material of *Cyathodium cavernarum* (the Type species), *C. aureonitens* and *C. tuberosum.*

Hepaticites cyathodoides sp. nov.

(Plate I A, B; Figs. 1A—J, 2A)

Diagnosis: Plant thalloid, dichotomising about every 4 mm., thallus lobes diverging at 60°—90°, apex notched. Thallus margin not waved. Midrib conspicuous, projecting ventrally, about 0·75 mm. wide, extending almost to apices. Thallus wings two cells thick, cells in rows, arching from midrib at about 30°, meeting margin at nearly 90°. Air chambers

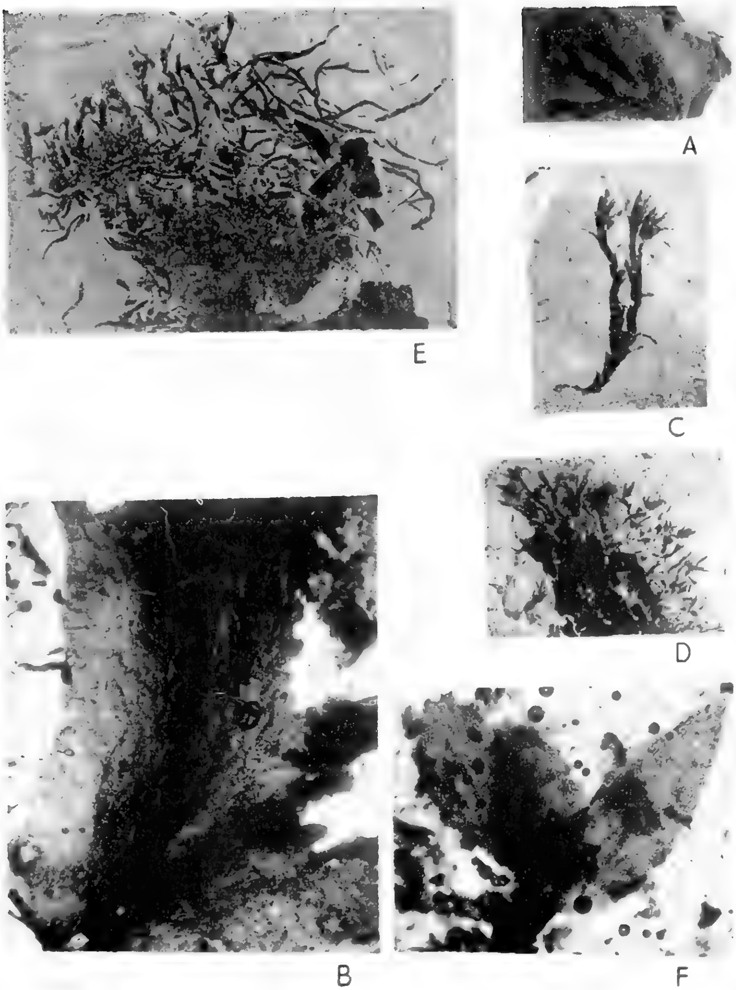

PLATE I. *Hepaticites cyathodoides*, A, B; *Muscites guescelini*, C–F.

A. The Type specimen before transferring. × 1·75.
B. Part of the thallus showing midrib and arrangement of the internal ribs. × 12.
C. The Type specimen. × 3.
D. Specimen showing a number of leafy shoots associated with a twig. × 1·5.
E. Specimens showing both leafless stems and leafy shoots. The moss is associated with debris, mostly leaf material. × 2.
F. Parts of three leaves to show the arrangement of the cells. × 18.

irregular, more conspicuous basiscopically; internal ribs curving out from midrib at about 30°, arching to nearly 90°. Ribs anastamosing mainly near margin, about 0·5 mm. apart. On thallus wing ventral cells slightly elongated, oblong, 43 $\mu \times 24$ μ (variation 20 μ — 12 μ), on dorsal surface similar but smaller. Cells over midrib tending toward rectangular, 45 $\mu \times 20$ μ. Rhizoids occurring basiscopically under midrib only, but toward apices occurring also away from midrib; minimum length 120 $\mu \times$ 8 μ, simple, maximum density seen, 13/ mm. of thallus length. Pores on dorsal surface about 50 μ across, normally nearly round, surrounded by one or two rows of small cells. Ventral scales minute, only present at apex, one cell high, 5—10 cells wide, forming one row across the midrib.

DESCRIPTION: The material consists of six small but very well preserved specimens, the largest (Plate IA) being designated the Type. Five are from the Waterfall locality, the sixth, which is identified with the Waterfall fossils, comes from the Australian Middle Triassic from the Brookvale plant bed (near Sydney). At the Waterfall all except one of the specimens occurred in rock devoid of other plant fossils; while the habit of the Type, and the fact that all the specimens were exposed dorsal side uppermost on splitting the rock (this was determined from the position of the rhizoids in transfer preparations) suggests that they may be preserved in the position of growth. The plant may have had a rosette habit.

The midrib showed on the dorsal side as an indistinct furrow, but I do not know whether it formed a furrow dorsally in life. On the ventral side the midrib always projected conspicuously.

The cellular structure was readily seen (Plate IB, Fig. 2A). The ventral cells were visible over nearly the whole thallus including the midrib, but were apparently rotted away in a few places. The dorsal cells were less distinct, being best seen where the ventral cells had rotted away and were never visible over the midrib.

The rhizoids (Figs. 1F, G, H) showed no signs of tubercles, cross walls or branching, but there was a suggestion that there may be two sorts, thick-walled and thin-walled rhizoids. The preservation does not allow certainty on this. It is also uncertain whether one sort of rhizoid was confined to one part of the thallus. The great majority of the rhizoids were broken off short, so that their maximum length is uncertain. The minimum length is obtained from a few small complete rhizoids (possibly immature) found at the apices, but the longest broken fragment was 240 μ long.

The internal ribs are shown in Plate IB and Fig. 1C. Before transfer in two specimens they appeared as very slight trenches on the dorsal side of the thallus, while in the other specimens they were not visible dorsally

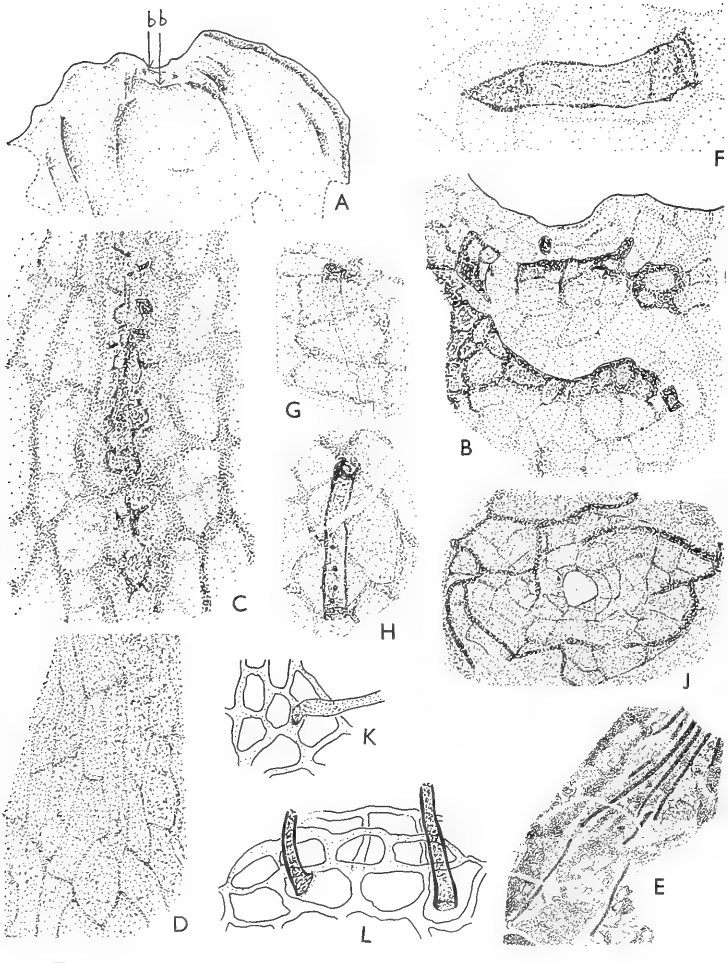

FIG. 1. *Hepaticites cyathodoides*, A–J; *Cyathodium tuberosum*, K, L.

A. Apex of a thallus-lobe, showing ventral scales (b . . . b) and longitudinal foldings. × 33. From the Type specimen.

B. The thallus-lobe apex shown in Fig. 1A., at greater magnification, showing ventral scales, and arrangement of ventral cell rows. × 262.

C. Cells of the thallus over an internal rib, showing two cell layers only away from the rib, but indications of more than two cell layers over the rib. × 475.

D. Cells over part of the thallus midrib. × 144.

E. A group of rhizoids over part of the thallus midrib. × 10.

F. A small complete rhizoid, showing point of attachment to a cell. × 262.

G, H. A thin-walled and a thick-walled rhizoid respectively. Each rhizoid is attached basally to a cell, but is broken off short. × 144.

J. A dorsal pore, and the cells around it. The heavier lines represent outlines of ventral cells, here mostly rotted away. × 262.

K, L The basal parts of a thin-walled and two thick-walled rhizoids respectively; L. also showing a ventral scale of abnormal form being only one cell high. (Ventral scale stippled). × 160.

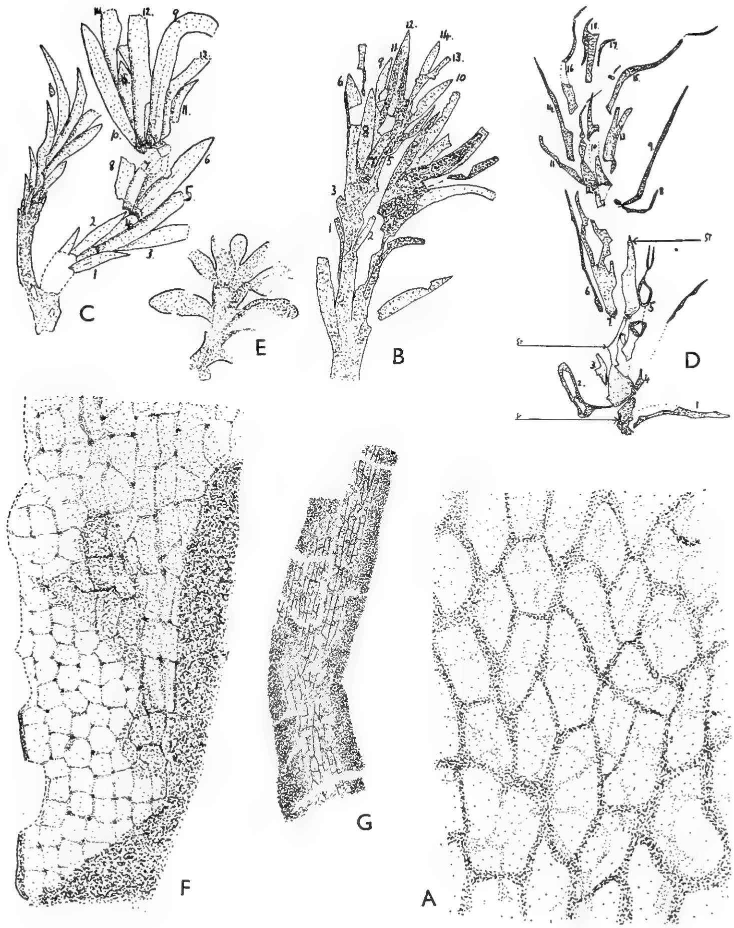

Fig. 2. *Hepaticites cyathodoides*, A; *Muscites guescelini*, B–G.

A. Part of the thallus away from the midrib, showing two cell layers. × 262.

B, C. Apices of two shoots, showing apical tuft of leaves, and numbers suggesting the phyllotaxis. Both apices compressed parallel with one bedding plane. × 14. B. from the Type specimen.

D. A shoot compressed so that it traverses several bedding planes, with numbers suggesting the phyllotaxis. Portions marked *St.* interpreted as part of the stem. × 16.

E. A shoot apex showing leaves oblong rather than lanceolate. × 14.

F. A leaf base showing the wide margin of square or hexagonal cells of thin substance, and central, elongated cells of thicker substance. The heavy stippling represents part of a (?) stem lying partly over the leaf base. × 176

G. Part of a stem showing epidermal cells, and thicker substance at the edges of the stem. × 25.

at all. On transfer they always appeared as dark lines, similar to, but smaller than, the midrib. The internal ribs did project very slightly on the ventral surface, but the ventral cells crossed them with, at the most, only very slight distortion (Fig. 1C) and there was no sign of plates or lamellae ventrally. It may be, indeed, that the slight projection ventrally is merely the result of compression. An internal rib was always composed of at least one other cell layer in addition to the dorsal and ventral epidermes, and probably more than one extra cell layer was present.

The objects interpreted as dorsal pores (Fig. 1J) were clearest in two specimens which, for some reason, had paler substance than the others. The form of the pores was not distinct, but they always appeared about at the centre of an air chamber, and I saw many of them all consistent with one another.

The ventral scales (Figs. 1A, B) were seen at four apices and there were never more than two reasonably complete ones at any apex, indeed, basiscopically, their (presumed) position is marked only by slight irregularities on the surface of the ventral cells and at the wider (? older) apices the scales were less complete than those figured. I could discover nothing about the form of the apical cell(s), but the form of the cell rows at an apex (Fig. 1B) suggests that it cut off cells on two sides only.

In all the specimens there were fairly prominent folds, especially over the midrib, and also flanking the apices, and sometimes at the margin. These folds were irregular in size and form and are not cellular structures. I suppose they may be connected with the process of fossilization.

DISCUSSION: (*a*) *The nature of the internal ribs.* There are, I suggest, three possibilities here:

(i) That they are a system of dorsal plates as are seen, for example, in species of *Riccia* and *Dumortiera* (see Coker 1903, Cavers 1911, Goebel 1930) or in *Petalophyllum* (see Mehra & Vashishti 1950, Mehra 1957);

(ii) that they are a system of ventral plates seen, for example, in some species of *Riccardia*, e.g. *R. fuegiensis* (see Goebel 1930);

(iii) that they are internal, some sort of partition within the thallus.

The first possibility is ruled out as, where visible at all dorsally, the internal ribs appear as furrows, not as upstanding structures. The second possibility can also be dismissed, for there is no sign of plates or cell rows over an internal rib, the whole ventral cell layer is undisturbed except, rarely, for a slight distortion of the cells. This means the internal ribs must be internal.

There are two further lines of evidence as to their nature. First, the pores on the dorsal surface, and their position roughly midway between

the internal ribs, strongly suggests a system of air chambers in the thallus. Secondly, the general form and disposition of the internal ribs closely resembles the general form and disposition of the partitions separating air chambers within the thallus of living Liverworts.

(*b*) *Comparisons of* H. cyathodoides *with living Liverworts.* The discoverable characters of *H. cyathodoides* indicate a surprisingly close resemblance to *Cyathodium*, and I am indebted to Dr. G. K. Berrie for first suggesting this similarity to me (selected references: Leitgeb 1881, Lang 1905, Khanna 1926, 1927, 1927a, Kashyap 1932, Chavan 1937, Schiffner 1924, 1938, 1939). The essential feature of the thallus of *Cyathodium* that sets it aside from other Liverwort genera is that the thallus consists only of a dorsal and ventral epidermis, separated by a system of air chambers that are bounded and separated by partitions, and that open dorsally by simple pores. As interpreted, *H. cyathodoides* has just this construction. Nearly all the other structures seen in *H. cyathodoides* can be matched in some species or other of *Cyathodium*, as is set out below.

H. cyathodoides	*Cyathodium*
(1) Thallus often forked, possibly of rosette habit	*C. griffithsii* of rosette habit (other species less forked)
(2) Midrib conspicuous	Midrib conspicuous in *C. foetidissimum* (inconspicuous or absent in other species)
(3) Air chambers irregular, better seen basiscopically	Air chambers irregular and better developed basiscopically in *C. cavernarum* (air chambers more or less regular in other species)
(4) Rhizoids not tuberculate, possibly thick walled and thin walled	Rhizoids never tuberculate, thick walled and thin walled; distinction rather obscure in *C. cavernarum* (plain in other species)
(5) Cells over midrib elongated, nearly rectangular	Cells over midrib elongated, nearly rectangular in *C. tuberosum* (less distinct from cells of wing in other species)
(6) Ventral scales minute, one cell high, 5–10 cells wide	Ventral scales always small, sometimes one cell high and up to 5 cells wide in *C. tuberosum* (form otherwise in other species)
(7) Ventral scales forming a single row over midrib	Ventral scales forming a single row over midrib apically in *C. foetidissimum* (in other species normally forming two rows).

There are differences; all, however, except one—the form of the dorsal pores—are either vague or can be explained away as an effect of fossilization. In *Cyathodium* the dorsal pores are, as far as I could discover, surprisingly few; normally somewhat elongated (though nearly round sometimes in *C. cavernarum*) and regularly surrounded by one to three rows of small cells with thin walls (Fig. 3A). But in *H. cyathodoides*

the dorsal pores are about twice as numerous as I could find for any species of *Cyathodium*; they are normally round, and the cells around them, though indistinct, do not seem to be much specialised. Moreover, some (but not all) species of *Cyathodium* have pores in the ventral epidermis; nothing like this was seen in *H. cyathodoides*. Another point is that the rhizoids in *Cyathodium* are twice to three times as numerous as in *H. cyathodoides*, and are 2 mm. long or more—thus much longer than any seen in *H. cyathodoides*. It may be also that the rows of cells seen in *H. cyathodoides* are more regular than pronounced than is normal in *Cyathodium*.

(c) *Comparison with certain other pre-Tertiary Liverworts.* The fossil liverworts have been discussed by Walton (1925, 1928) and, more recently, by Harris (1942), Steere (1946) and Lundblad (1954, 1955). The Tertiary ones look very like living genera, and I leave them aside. Of the pre-Tertiary fossils there are eight which require individual attention now; six because they have structures suggesting an air-chamber system within the thallus, and two because they come from a flora containing *Dicroidium*.

The plants that may have an air-chamber system in the thallus are these:

(i) *Ricciopsis florinii* Lundblad (1954). This plant shows a markedly rosette habit, with very crowded segments, each showing a distinct dorsal furrow. Its rhizoids arise from all over the thallus, especially from the margins, and are 1—2 mm. long. Some are tuberculate, others smooth walled, while yet others show evidence of cross walls and branching. Ventral scales were not observed. The thallus is certainly thick but its internal structure is obscure. At least some of the thallus cells are more or less isodiametric, not elongated.

(ii) *Ricciopsis scanica* Lundblad (1954) also has a rosette habit, and dorsally grooved segments, but the segments are less crowded than in *R. florinii*. Ventral scales and rhizoids were not observed. The thallus wing is at least two cells thick, the cells forming curving rows from midrib to margin. Internal ribs (whose exact nature is left open) are present, arching out to the margin, and about 0·2 mm. apart. These ribs do not anastomose, but sometimes fork near the margin. Both species of *Ricciopsis* are from the Lower Liassic of Scania, Sweden.

(iii) *Marchantites hallei* Lundblad (1955) is a large plant, up to 6 mm. wide, and shows well-marked ovate ventral scales along the whole thallus length. The scales, and also the rhizoids, are borne upon thickenings of the thallus that curve out to the margin. The rhizoids are of two sorts, clear and with dark

contents. Air pores are numerous and are believed to be cone or barrel-shaped, and in the figures appear to be elevated. *M. hallei* come from the Lower Cretaceous of Patagonia.

(iv) *Marchanteolitus porosus* Lundblad (1954) consists of some rather small fragments of a thallus showing elevated air pores sur-

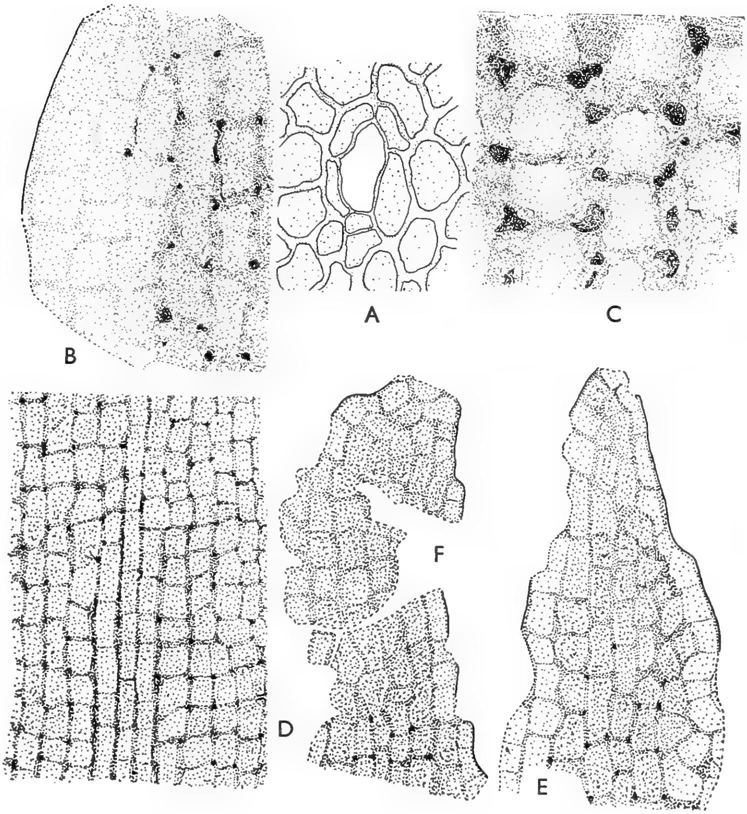

FIG. 3. *Cyathodium aureonitens*, A; *Muscites guescelini*, B–F.

A. A dorsal pore and surrounding cells (cf. Fig. 1 J.) × 160.

B. Part of the margin of a leaf, showing square marginal cells, and (at top) their mode of formation, and elongated central cells of thicker substance. × 316.

C. Cells from an oblong leaf, showing papillae at the corners of the cells, over the cell walls. × 316.

D. Cells from a leaf, showing the apex of a strip of elongated cells. × 176.

E. A leaf apex (nearly complete, as interpreted), showing formation of the cell rows and of the margin of square cells. × 176.

F. A further leaf apex, broken off a little below that shown in Fig. 3 E., but showing similar formation of cell rows and square cells at leaf margin. × 176.

rounded by several rows of apparently modified epidermal cells. It is from the Lower Liassic of Scania.

(v) *Hepaticites wonnacotti* Harris (1942) is a large plant with a thallus up to 12 mm. broad and with rhizoids up to 40 μ wide. Ventral scales were not seen. The internal structure of *H. wonnacotti* is obscure. The surface shows rather numerous bulges that are internal structures and might be the remains of an air-chamber system. There are also internal thickenings of the thallus; these are best seen acroscopically, and do not anastomose, but are sometimes forked (at about 20°) near the margin. Harris tentatively compared these thickenings with the ribs bearing rhizoids and ventral scales found in some Marchantineae.

(vi) *Hepaticites haiburnensis* nom. mnscr. Harris, differs from *H. cyathodoides* in being considerably larger and in showing prominent ventral scales. Both *H. wonnacotti* and *H. haiburnensis* are from the Middle Jurassic Deltaic Series of Yorkshire.

The two fossils from a *Dicroidium* containing flora come from Victoria and are described by Medwell (1954). One is called *Marchantites erectus* and is not figured. This name, however, is a synonym of *Hepaticites arcuatus* (L. & H.) Harris (1942). The other is named *Thallites* (originally *Marchantites*) *barwoni* (Medwell) Lundblad (1955). This fossil shows no features that place it definitely in the Bryophyta, and appears to be preserved as an impression only. It consists of two dichotomising thalli, about twice as large as *H. cyathodoides,* and forking at a narrower angle (about 20° from the figure). The margins appear to be waved or scalloped.

As will be seen, none of the above plants are very like *H. cyathodoides*; indeed, *H. cyathodoides* stands rather apart from the other fossil liverworts that are known in any detail.

Since the reproductive structures of *H. cyathodoides* are unknown (and I make no assumptions about their form), I prefer to use the non-committal name *Hepaticites* while indicating the most likely similarity in the trivial name. *Cyathodium* used to be placed in the Targioniaceae, but is now removed to a family on its own (Müller 1952, Reimers 1954); the present specimens do not shed any light on the affinities of *Cyathodium*, but they do indicate that Liverworts with a thallus structure like *Cyathodium* have been distinct for a very long time.

MUSCINEAE

Muscites guescelini

This species is represented by fifteen specimens, twelve of which were made into balsam transfers. The material is well preserved but, as with

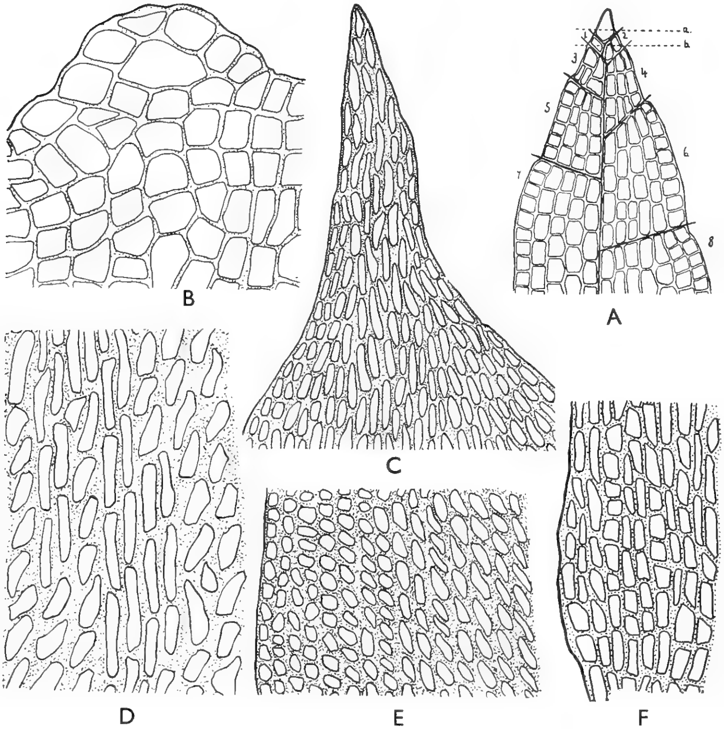

FIG. 4. *Muscites guescelini* (reconstruction), A; *Haplomitrium hookeri*, B; *Leucodon assimilis*, C; *L. giraldii*, D, E; *L. brachypus*, F.

A. Reconstruction of the leaf apex (somewhat diagrammatic) to show formation of cell rows and margin of square cells from the apical cell. The numbers 1–8 to indicate successive divisions of the apical cell; the lines marked *a* & *b* to show the respective levels at which the leaf apices shown in Figs. 3 E, F., are broken off (as interpreted). × 118, approx.

B. A leaf apex to show the arrangement of the cell rows. *Note*, further from the apex the transverse arrangement of cell rows becomes obscured, the cells appearing to be set irregularly. × 160.

C. The leaf apex, showing arrangement of cell rows (cf. Fig. 4 B.), and mode of formation of the square cells at the margin. × 176.

D. Cells near the leaf base, showing a narrow strip of elongated cells (centre). × 475.

E. Cells at the margin near the leaf base, showing the inner cells secondarily set in oblique as well as longitudinal rows. × 241.

F. A leaf showing rectangular cells. × 160.

Hepaticites cyathodoides, some features inevitably remain obscure; so, as in that case, I have made the assumption that the plant was not originally more complicated than it now appears to be.

In order to facilitate the comparisons made in this section, I have examined material of *Naiadita lanceolata* (collected by Professor Harris), and herbarium material of *Haplomitrium hookeri*, most of the genera of the Leucodontaceae, and of various other mosses that showed points that seemed to be valuable for comparison.

The specific name is given after Jocelyn E. S. Townrow, who discovered the first specimen.

Muscites guescelini sp. nov.

(Plate IC—F: Figs. 2B—G, 3B—F, 4A)

Diagnosis: Gametophyte showing sparingly branched stems with an apical tuft of leaves, but leafless below, leafy stems about 1·5 cms. long. Branching apparently equal. Stems about 2 mm. wide and showing elongated epidermal cells about 40 $\mu \times 20$ μ. Leaves borne spirally (probably $\frac{3}{8}$) and diverging radially, but at small angle to stem—about 15°, inserted transversely and sheathing for the basal 0·2 mm., margins strongly involute. Free part normally lanceolate, 2 mm. long (extremes 1·25 mm. and 2·5 mm.) and 0·5 mm. wide (extremes 0·25 mm. and 0·75 mm.). Leaf only one cell thick all over, and without a nerve. Leaf cells normally elongated longitudinally, rectangular or hexagonal, 35 $\mu \times$ 25 μ (variation 27 μ and 15 μ). Strips of more elongated cells present, around 50 $\mu \times 20$ μ; one to three such strips present, occupying about $\frac{1}{3}$ leaf width at leaf base, and extending $\frac{1}{4}$—$\frac{1}{3}$ the length of the leaf. Cell walls about 11 μ thick. All cells set in distinct longitudinal rows, about 20 cell rows per leaf. Cells normally showing thickening or low papilla at corners, papillae up to 10 μ across. Margin showing one row of roughly square cells apically, three or four rows below, at leaf base roughly square cells occupying about $\frac{1}{4}$ leaf width. Marginal cells about 30 μ across, cell walls about 8 μ thick, without papillae. Marginal cells at leaf base sometimes hexagonal, and with papillae. Leaf widening by addition of cell rows to margin, each new row forming a "shoulder" at the leaf edge. Paraphyllia absent. (Rhizoids and reproductive structures unknown.)

Description: The leafy parts of the stems branch at a narrow angle (about 20°), but the leafless stems sometimes show branching nearly at right angles (Plate I E). Most of the stems are now represented by a more or less uniform brown substance, rather obscurely showing the epidermal cells and with indications of several (I do not know how many) cell layers within. A number of specimens show rather darker areas

marginally (Fig. 2G), which probably indicates that there were thickened cells around the periphery of a stem. There was no indication of any central strand of thick cells, which might be expected on compression to show up as a thicker, darker area centrally. Presumably, therefore, any central strand was composed of thin-walled cells only. All the stems are of about the same diameter, so I suppose they were originally round in section, not flattened.

The leaves were certainly borne spirally (Figs. 2B–E) but the phyllotaxis proved hard to determine since all but two rather incomplete specimens were flattened along one bedding plane, and because the leaves were commonly crowded in the apical tuft. The phyllotaxis was not $\frac{1}{3}$, and the value given in the diagnosis $\frac{3}{8}$ fitted the eight specimens that showed a reasonable length of leafy stem better than $\frac{2}{5}$ or $\frac{5}{13}$. It is possible that the phyllotaxis is a more complicated value, but I do not think this is likely. None of the specimens showed any signs of dorsi-ventrality and all, especially those compressed at an angle to the bedding planes, show that the leaves diverged radially. Figs. 2B, C, show the sheathing leaf base and their transverse insertion. There is no evidence preserved suggesting much (if any) torsion of the stem during growth.

The leaf shape varied considerably; the normal form is as given in the diagnosis but, in general, the leaves tended to become more oblong apically, and at one apex (Fig. 2E) oblong not lanceolate leaves are visible. In all cases, however, the leaf was formed of about 20 longitudinal rows of cells, the cells varying in shape, from considerably elongated in the narrow leaves to less elongated and even nearly square in the wider and oblong leaves (Figs. 3B–D). Square cells, away from the margin, were rare. Rectangular cells were commoner than hexagonal cells, and in the hexagonal cells the corners remained angular, not rounded (Plate I F). In the strip or strips of elongated cells the shape was regularly rectangular as it was, too, in the elongated cells at the base of the leaf (Figs. 2F; 3D). I regard the concavity of the leaf at its base as an inevitable consequence of the leaf being wider than the stem. The leaf margin was strongly involute, making the marginal cells difficult to see in many cases.

In none of the specimens could I find any evidence that the leaf was anywhere more than one cell thick.

The longitudinal cell rows are always very distinct, being perhaps, the most prominent feature of the material (Plate IF; Figs. 3D, E). The thickening or papilla at the cell corners was visible nearly everywhere, but most plainly in wide cells. As interpreted, this is not simply a collenchymatous thickening, but, at least where well developed, a distinct protuberance (Fig. 3C for projecting papillae). The marginal

cells were rather often eroded away, but were plain in places (Plate I F; Fig. 3B). As they are paler and have thinner cell walls than the other cells, I suppose they had thinner substance. These cells are square, or if elongated at all, then elongated transversely and so stand out plainly from the rest of the leaf. They become distinct only a very little way behind the leaf apex, while the number of rows of marginal cells increases, passing down the leaf, by division of the row of cells just within the margin (Fig. 3B). At the leaf base the margin is wide, and its cells sometimes papillose, but they still remain paler than the other cells of the leaf (Fig. 2F).

No leaf showed the apex distinctly, but several (Figs. 3E, F) showed the region just behind the apex, and including the base of the apical cell. This cell shows two basiscopic faces to which the longitudinal rows of cells can be traced back. At the leaf apex, however, the cell rows are not quite longitudinal, but cross slightly zigzag fashion over a line bisecting the leaf longitudinally (see especially Fig. 3E). Later this zigzag arrangement gives place to strict longitudinal rows. The transverse divisions set in earlier in the marginal cell row than centrally. The marginal cells immediately behind the apex were elongated (Fig. 3E). New cell rows are added (*a*) to the margin: as already noted, at each increase the leaf edge bulges out in a "shoulder" (Figs. 3E, F), and (*b*) apparently irregularly by longitudinal division of a cell situated toward the centre of the leaf.

The shoots were examined for paraphyllia, but nothing resembling paraphyllia was found. It follows, I suppose, that they were absent in this species. Also the stems and the mud left from the transfer process were carefully examined for rhizoids, but, again, none were found. In a few places the cell walls showed slight semicircular hollows, but, as they followed no decipherable pattern, I suspect these hollows are not original features.

DISCUSSION: (*a*) *The form of Muscites guescelini.*

Seven of the specimens appeared mixed up with leaf fragments, twigs and other debris (Plate I D, E) and four others were only small. All, moreover, showed some erosion at the margins and apex. This strongly suggests that this plant is *not* found in its position of growth, but presumably not far from it as most specimens are reasonably complete. It is, thus, not possible to be certain of the habit of *M. guescelini*. However, the different sorts of branching seen in the leafy and leafless stems, and the abundance of leafless stems do suggest that the adult plant had a system of creeping leafless stolons from which leafy branches arose at a wide angle. As the leafy shoots branch more or less equally,

and at a narrow angle, I think it most unlikely that the branching was pinnate.

The form of segmentation of the leaf and the form of the apical cell are of great importance in classifying the material. There are three possibilities.

(*a*) That a basal meristem was present, or scattered meristematic cells. The regular arrangement of the cell rows, and the fact that the cell rows can readily be traced back to an apical cell, definitely, I suggest, exclude this possibility.

(*b*) That an apical meristematic cell was present, cutting off cells from only one basiscopic face. This situation is seen among the liverworts (see e.g. Schiffner 1924, Campbell 1927, Goebel 1930, Harris 1938), and leads to transverse cell rows in the leaf (see Fig. 4B), though sometimes the cell rows also take on a secondary longitudinal orientation. This is not the arrangement seen in *M. guescelini.*

(*c*) That an apical meristematic cell was present, cutting off cells from more than one basiscopic face. This is seen among the mosses (see e.g. Lotsy 1909, Wettstein 1924, Ruhland 1924, Campbell 1927, Goebel 1930), and leads to a leaf showing converging cell rows; that is, the cell rows cross zigzag fashion across a line bisecting the leaf longitudinally. In many mosses the original segments of the apical cell become flattened out by more rapid cell division at the leaf margin, and then the cell rows come to lie longitudinally (Fig. 4C). This is exactly the arrangement seen in *M. guescelini*, and I conclude, therefore, that cells were cut off from more than one basiscopic face of an apical cell that was probably triangular or rhombic in surface views (see reconstruction, Fig. 4A).

(*b*) *The ascription of M. guescelini to the Muscineae.*

M. guescelini shows a set of characters that today are only found among the Bryophyta, and so I place it here. It also shows, especially in its leaf arrangement and form, and in its cell pattern, a combination of characters that distinguish it sharply from any of the leafy Jungermanniales. The only leafy liverworts that resemble *M. guescelini* at all closely are the Calobryales (see e.g. Gottsche 1843, Goebel 1891, Campbell 1920, Buch 1930, Harris 1938) and the Rhaetic fossil *Naiadita lanceolata* (see Harris 1938, 1939). These two groups have radially symmetrical shoots*, round stems and transversly inserted leaves that are spirally borne.

* The shoot of the Calobryales is sometimes taken to be truly radial, and sometimes as dorsiventral but approaching radial (see Harris 1938). I here regard the shoot as truly radial. If it be taken as essentially dorsiventral, then the comparison with *M. guescelini* is much weakened.

However, both the Calobryales and *Naiadita* show, at least in the young leaf (see Campbell 1920 on *Calobryum*), the cell segmentation that is apparently universal among the liverworts (see above, p. 15)) whereas *M. guescelini* shows, as interpreted, the cell segmentation found among the mosses. This difference I regard as extremely important, for it separates all liverworts from all the mosses, except for three genera. These genera are, *Andrea* (see Kühn 1871, Pottier 1921), *Buxbaumia* and *Diphyscum* (see Goebel 1930), and I am inclined to set them aside as they are all anomalous in other respects.

(*c*) *Comparison of* M. guescelini *with the Leucodontaceae.*

As it is interpreted, *M. guescelini* can be matched in a considerable number of features, and in fairly satisfactory detail, with members of the Leucodontaceae, especially with the Leucodontoideae* (see e.g. Okamura 1916, Brotherus 1925, Dixon 1936, Noguchi 1936, 1948), and I am indebted to Dr. E. V. Watson for pointing this out to me. Comparison is close in size, habit, leaf form, cell pattern, shape and ornamentation, and in the absence of paraphyllia. But the comparison is not perfect. There are the following difficulties. (*a*) The apical tuft of leaves commonly seen in *M. guescelini* is scarcely matched, though some species, e.g. *Leucodon giraldii*, approach closely; (*b*) the longitudinal cell rows of *M. guescelini* are more regular than, apparently, in any of the Leucodontaceae, though most species of the Leucodontoideae (but not of the Antitrichoideae and Pterogonoideae) are similar (see Figs. 4C, E); (*c*) the cell dimensions of *M. guescelini* are only just comprehended within the limits of cell dimensions, as far as I can discover them, of the Leucodontaceae; (*d*) some species of the Leucodontoideae, e.g. *Leucodon brachypus* (see Fig. 4F), have rectangular, rather regular, cells, but most species in this, and the other, sub-families may have cells somewhat differently shaped.

There is also one absolute difference; in the Leucodontaceae the periclinal walls of the marginal cells are thicker than the periclinal walls of the other cells, but in *M. guescelini* the reverse is the case.

However, in addition to the correspondence referred to in general terms above (p. 16), there are two particular similarities. These are (*a*) the form and mode of development of the square marginal cells, which appear to be identical in *Leucodon* (Fig. 4C), and possibly some other genera, and *M. guescelini*; and (*b*) the papillae over the cell walls at the corners, which are seen in *Leucodoniopsis* and *Pseudocryphaea* (Antitrichoideae), and rarely in *Leucodon*, e.g. sometimes in *L. capensis*.

*The Leucodontaceae are divided into three sub-families (see Reimers 1954), the Leucodontoideae, Antitrichoideae and Pterogonoideae. The chief genus, *Leucodon*, contains about two thirds of the species.

These resemblances are, I think, important, for these characters are only shown by a few other mosses that are otherwise widely different from *M. guescelini* (see pp. 17, 18).

(*d*) *Comparison of* M. guescelini *with other mosses.*

A considerable number of mosses resemble *M. guescelini* in one or two points, but differ in more. Many genera have a similar habit, especially in the Families, Bryaceae, Tortulaceae, Dicranaceae, Pottiaceae, Rhacopilaceae, Heterocladiaceae and Amblystegiaceae, but show no other point of approach. Also some genera show papillae over the cell walls at the corners, for example certain of the Bartramiaceae, or *Oxyrrhynchium* (Brachytheciaceae), but, again, these mosses are otherwise quite different from *M. guescelini*. Table I (p. 18) sets out in more detail some of the characters of a number of groups that show similarities in more than one respect to *M. guescelini*, but it will be seen that none come very close.

In conclusion, though the gametophyte of *M. guescelini* is not typical of the gametophytes of the Leucodontaceae, it is much nearer that family than any other. Moreover it shares with the Leucodontaceae two features that are not common among mosses (the form and mode of development of the marginal cells, and papillae over the cell corners) and that are only shown by mosses otherwise very different. Since there is no information about the sporophyte of *M. guescelini*, and in view of its antiquity, I prefer to leave its affinities open and use a non-committal generic name.

GENERAL DISCUSSION.

Species of fossil liverworts are few; there are scarcely twenty fossils known in enough detail for their classification as liverworts to be convincing, though there is a considerably greater number of (mainly) thalloid fossils whose fine structure is unknown, and which it is therefore unrewarding to discuss (see Steere 1946 and Lundblad 1954, 1955). Only two species are known fertile, *Marchantites sezannensis* from the Tertiary of the Paris basin, and *Naiadita lanceolata* from the English Rhaetic. Leaving aside all the Tertiary and later records, the remaining liverworts fall, with very few exceptions, into three groups. The first is a group from the English Coal Measures (Westphalian); the second is a group from the Rhaetic and Liassic, mainly of Sweden and Greenland, but including *Naiadita*; the third is a group from the Middle Jurassic of Yorkshire. Our knowledge, therefore, of the history of the Hepaticae, both as regards morphology and distribution, is markedly deficient. Yet it is peculiar in some respects, for the pre-Tertiary sterile fossils

TABLE I.
Comparison of certain Mosses with *Muscites guescelini*

Plants	*Habit*	*Leaf Form*	*Cell Pattern* (a) Margin	*Cell Pattern* (b) Other cells	*Cell Pattern* (c) Strip of elongated cells	*Paraphyllia & Cell Ornamentation*
Fontinalaceae	Larger than *M. guescelini*, otherwise similar	Larger than *M. guescelini* other wise similar	No margin of quadrate cells	Cells rhombic, cell walls thinner than *M. guescelini*	Absent	Cells smooth
Hookeriaceae	Without leafless stolons (except *Hookeriopsis*)	Leaves scarcely sheathing, apex often blunt, sometimes with nerve	Rarely with margin like *M. guescelini* (e.g. *Crossomitrium*)	Cells mostly rhombic with thinner walls than *M. guescelini*	Absent or very feeble	Cells smooth
Leskeaceae, especially Leskeoideae	Habit similar to *M. guescelini*	Leaves with nerve	Cell pattern sometimes, but margin rarely like *M. guescelini*	Distinct from *M. guescelini*	Strip replaced by nerve	Cells with centrally placed papilla, or smooth
Cryphacaeae, especially *Bestia* and *Forsstroemii* (Alsioideae)	Branching pinnate or rub pinnate	Often with nerve	Margin like *M. guescelini* in *Forsstroemia* only	Cells set in oblique rows, shape like *M. guescelini* in *Bestia*	Strip usually replaced by nerve	Cells smooth, Paraphyllia normally present
Erpodiaceae especially *Venturiella* and *Aulacopilum*	Habit similar, but plants only about ¼ size of *M. guescelini*	Nerve present in some species of *Aulacopilum*	*Venturiella* with similar margin	Cells not, or scarcely elongated	Absent, replaced by nerve in some species of *Aulacopilum*	Cells smooth, or papillae centrally placed in some species of *Aulacopilum*

look like members of living families, or even genera, and not like intermediates between families and genera. In this respect *Hepaticites cyathodoides* is like most other pre-Tertiary liverworts.

The records of fossil mosses are even scantier (see Dixon 1927, Steere 1946). In the Quaternary and later Tertiary many mosses are known, that belong, it appears, to living genera; in the earlier Tertiary there are a few, two or three with fruit, but none known in cellular detail; while from the pre-Tertiary there are (excluding two or three doubtful leaf fragments) only two, both from the Upper Carboniferous (Stephanian) of St. Ettienne, and both sterile (see Walton 1928). One, *Muscites polytrichaceaus*, is a leafy shoot of moss-like habit but unknown structure, the other, *M. bertrandi*, is a transverse section of an axis showing some moss-like structure, but of unknown habit and leaves. Walton summarises the evidence from these records as follows (p. 714): "there seems little reason to doubt the presence of mosses at least as far back as the Stephanian (Upper Carboniferous) but what their relationships to the living *Musci* were cannot yet be decided". *Muscites guescelini*, on the other hand, because it can be compared fairly closely with a living family, parallels the pre-Tertiary liverworts.

One is bound to ask the question to what extent these, sometimes close, similarities in gametophyte structure can be taken to indicate relationships. For the pre-Tertiary I suggest it is not safe to assume any relationship, though it may exist and might be close. The reasons for this view are as follows:

(i) There are few fossil bryophytes known and, except *Naiadita*, those that are known are sterile. Often their preservation scarcely allows of reasonable certainty even of their gametophyte structure. They thus shed little or no light on the evolution of the group; so that it is hardly possible to decide whether the fossils that look like living plants are related to them, or are unrelated, merely having evolved a somewhat similar thallus form.

(ii) Even those fossils that approach nearest to living forms, e.g. *Ricciopsis florinii*, still show definite points of difference that may well be paralleled by differences in their reproductive structures that are as yet unknown. The uncertainty of classifying sterile material remains even in groups, e.g. the conifers, whose fossil history is vastly better known than that of the Bryophyta.

(iii) The case of *Naiadita*, which is the only fossil bryophyte known fertile and in cellular detail, supports arguments for a conservative approach to this question. This plant proved very

difficult to classify. Had *Naiadita* been known sterile it might have *appeared* easier to classify; it might have been ascribed to the Calobryales, especially if its rhizoids had also not been preserved.

For reasons such as these, schemes which attempt to utilise such sterile and imperfectly known fossil bryophytes to support a particular theory of evolution are not convincing, because these same fossils could equally well be used to support almost any other theory (see Mahra 1957).

I would also suggest that, for the pre-Tertiary, it is not yet worth-while multiplying generic names unless they are based (like *Ricciopsis*) on both form and detailed structure. I think there is little, if any, gain, for example, in transferring *Hepaticites glebosus* to a new form genus *Metzgerites* on the strength of its wavy margin and sparingly forked thallus (see Steere 1946).

A feature that proved of the greatest value in discussing *Muscites guescelini*, and was also most valuable in the case of *Naiadita* (see Harris 1938), is the segmentation of the leaf. Indeed, it seems that, for fossil material, this character may be of even greater value than the difference in rhizoid form used to separate the Liverworts and Mosses which is more often mentioned. The cells of the leaf quite often seem to have been better preserved than the rhizoids, and even the rhizoid character has exceptions (see Lundblad 1954), a few liverworts showing septate or branched rhizoids like the Mosses. I imagine that the mode of segmentation may usually be deduced even if the actual apical cell is missing.

A final point worthy of mention, but not to be pressed too far, is that the two species here discussed most closely resemble plants that are now mainly tropical.

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THE SOUTH AFRICAN SPECIES OF AIZOACEAE

VI. ACROSANTHES

by

R. S. Adamson.

ACROSANTHES

Acrosanthes is a small genus distinctive in both floral structure and in habit which is confined to the western and south-western part of the Cape Province.

By most authors the genus has been regarded as being closely allied to *Aizoon* and *Galenia* (e.g. Fenzl Ann. Wien. Mus. 2: 218. 1840: Sonder Fl. Cap. 2: 471. 1862; Benth. & Hook. Gen. Pl. 1: 823. 1867; Pax in Eng. & Prantl Nat. Pflznf. 3. 1b: 43. 1889; Phillips Gen. S. Afr. Pl. ed. 2. 293. 1951; Friedr. Mitt. Bot. Munch. 12: 58. 1955). It was treated as a subgenus of *Aizoon* by Dietrich Syn. Pl. 3: 130. 1847. On the other hand, K. Müller, Bot. Jahrb. 42. Beibl. 17: 54—98. 1908, transferred it to the tribe Mollugineae and placed it in close association with *Limeum*, largely on account of the solitary basal ovules. His view was followed by Pax & Hoffmann, Eng. & Prantl Nat. Pflznf. ed. 2. 16c: 194. 1934. The general floral structure seems more in keeping with the former view.

ACROSANTHES

Ecklon & Zeyher Enum. 328. 1837.

Aizoon subgen. *Acrosanthes* D.Dietr. Syn. Pl. 3: 180. 1847.

Glabrous prostrate or sprawling perennials. Stems woody at least at the base. Leaves opposite, exstipulate, usually connate at the base. Flowers solitary at the nodes, pedunculate, bisexual. Perianth 5-lobed the segments green outside, white inside, united at the base, the lobes longer than the tube. Stamens 8 to numerous, inserted on the lower part of the perianth, sometimes in groups. Disc wanting. Ovary superior, 2-chambered but often incompletely so, with one basal ovule in each chamber: stigmas two, short. Fruit thin-walled, usually 1-chambered, with 1 or 2 seeds. Seeds compressed, reniform or orbicular, rugose.

The type species is *A. anceps* (Thunb.) Sond. (*A. fistulosa* E. & Z.).

The solitary flowers have often been described as being axillary but they are really terminal and the flowering shoot a sympodium. When creating the genus Ecklon & Zeyher described three species. Sonder

Fl. Cap. l.c., added a fourth. Since that time the genus has received little attention. Five species are now recognised, one being described for the first time.

KEY TO THE SPECIES.

1\. Leaves terete or semiterete: flowers 0·5—0·8 cm. long: stamens numerous .. .. 5. *teretifolia*

1\. Leaves flat, oblanceolate, oblong or obovate: flowers not over 6 mm. long: stamens not more than 20.

  2\. Flowers on peduncles at least as long as the perianth: perianth segments not keeled on the back.

    3\. Leaves 1—2 cm. long, up to 0·5 cm. wide: flowers 5—6 mm. long: perianth segments unequal: stamens 15—20: stems with prominent opposite ridges .. 1. *anceps*

    3\. Leaves not over 1·2 cm. long, and 3 mm. wide: flowers 2—3 mm. long: perianth segments about equal.

      4\. Leaves oblanceolate, slightly narrowed to the base: flowers about 3 mm. long: stamens 12—20: green or brownish prostrate plant .. 2. *angustifolia*

      4\. Leaves ovate, petiolate, small: flowers 2 mm. long: stamens 8—10: blackish plant in close flat mats .. .. 4. *microphylla*

  2\. Flowers sessile or on peduncles shorter than the perianth: perianth 4—6 mm. long, the segments keeled on the back 3. *humifusa*

1\. **A. anceps** (Thunb.) Sond. Fl. Cap. 2: 272. 1862.

Trianthema anceps Thunb. Prod. Pl. Cap. 80. 1794.

A. fistulosa Ecklon & Zeyher Enum. 328. 1837.

Aizoon fistulosum D.Diet. Syn. Pl. 3: 130. 1847.

Stems woody at the base, up to 50 cm. long, often much branched, the younger bright brown, the internodes with opposite acute ridges. Leaves oblong or obovate to oblanceolate, rather thick, 1—2 cm. long, 0·2—0·5 cm. wide, mucronate-acute to acuminate, distinctly narrowed to the base. Leaves spreading or secund ascending. Flowers on spreading or deflexed flattened peduncles 0·8—3 cm. long. Perianth 5—6 mm. long, the lobes acuminate, two longer than the others. Stamens 15—20: anthers white. Fruit rounded, mucronate, slightly shorter than the perianth. Seeds black, obtusely tuberculate.

The type is in herb. *Thunberg* U.

Stones or gravel on the lower mountain slopes in the western part. Leaves often brown, sometimes glaucous. Very variable in size and in the amount of branching. Internodes from 2·5 cm. long to very short. In exposed sites the whole plant may be compact and mat-like.

CLANWILLIAM. Heerenlogement *Zeyher* 2146 S.SAM: Grasruggens *Pillans* 8800 BOL: Keerom *Esterhuysen* 17874 BOL: *Pillans* 8776 BOL: Algeria *Lecyns* CT.

PIKETBERG. Piketberg Mt. *Bolus* 7547 K: *Guthrie* 2613 NBG: *Zinn* SAM.

TULBAGH. Waterfall *MacOwan* 1615 BM.G.K.SAM; Tulbagh *Schlechter* 7479 BM.BOL.G.K; Witzenberg *Zeyher* 721 BM.BOL. G.K.S. SAM; Roodesandberg *Adamson* 1025 CT: *Compton* 6563 BOL.NBG; Tulbagh Kloof *Zeyher* 11 S.

WORCESTER. Goudini Baths *Adamson* 4410.

Without locality:—*Drege* (*A. fistulosa*) S; *Thunberg* G.

2. **A. angustifolia** Ecklon & Zeyher Enum. 328. 1837.

Aizoon angustifolium Diet. Syn. Pl. 3: 130. 1847.

Stems woody, branched, with internodes as long as the leaves or much shorter, the younger with small opposite ridges, the older terete. Leaves oblanceolate to linear-obovate, 0·4—1·2 cm. long, about 0·2 cm. wide, acute, usually mucronate, slightly narrowed to the base. Flowers on peduncles 0·3—1 cm. long. Perianth about 3 mm. long, the lobes acute, almost equal, the inner with membranous edges. Stamens 12—20. Fruit shorter than the perianth. Seeds black, rather finely rugose.

The type is *E. & Z.* 2147 B(lost), cotype S.

Sand or stones on mountains along the west coast.

Variable in the amount of branching and in the length of the internodes. Fenzl, Ann. Wien. Mus. 2: 271. 1840, described two varieties (*a*) *dodecandra* with very short internodes, and (*b*) *icosandra* with longer ones. There does not seem to be any other real distinction between them, nor is there any clear-cut line of separation. The differences seem largely the result of habitat conditions and the varieties cannot be maintained. The species is much like *A. anceps* and often confused with that in collections. It is distinguished by a more woody habit, much narrower leaves, smaller flowers with almost equal perianth segments, and by smoother seeds. The confusion between the species has been partly due to Sonder having referred *Zeyher* 721 to a variety of this species. It is certainly a slender form of *A. anceps*.

CLANWILLIAM. Pakhuis Pass *Acocks* 15040 K.PRE: Elandsfontein *v. Breda* 220 K.PRE; Algeria *Lewis* BOL.

PIKETBERG. Piketberg Mt. *Bodkin* 7547 PRE: *Drege* S.

CERES. Olifants Riv. *Esterhuysen* 13457 BOL; Schurfteberg *Primos* SAM; Tafelberg *Esterhuysen* 3942 BOL.

TULBAGH. Waterfall *Compton* 12403 NBG: *Ecklon & Zeyher* 2147 S; *Leighton* 181 BOL.

WORCESTER. Botha *Compton* 18685 NBG.

Without locality:—*Drege* (*Didaste decandra*) BM.G.K.TCD.

3. **A. humifusa** (Thunb.) Sond. Fl. Cap. 2: 472. 1862.

Trianthema humifusa Thunb. Prod. Pl. Cap. 80. 1794.

A. decandra Fenzl. Ann. Wien. Mus. 2: 270. 1840.

Yellow-green, in flat patches, up to 30 cm. across. Stems woody, with numerous short branches. Leaves secund, ascending, crowded, oblong obovate or almost spatulate, 4—6 mm. long, 1—3 mm. wide, acute, narrowed to the base, distinctly connate. Flowers about as long as the leaves. Peduncles 0·5—3 mm. long. Perianth 4—6 mm. long, the segments acute or acuminate, keeled on the back at least at the tip. Stamens about 10. Fruit as long as the perianth. Seeds flat.

The type is in herb. *Thunberg* U.

Rather rare on mountains on the west coast.

Rather pale green or yellowish. Distinguished from compact states of other species by the erect secund leaves, the almost sessile rather large flowers, and the keeled perianth segments.

CLANWILLIAM. Wuppertal *MacOwan* 3271 SAM: Heuning Vlei *Esterhuysen* 7481 BOL.SAM, 15016 BOL.NBG.PRE: Blaauwberg *Drege* S.

CERES. Sandfontein *Schlechter* 10142 BM.BOL.K.G.S.; Gydoberg *Bolus* BOL.

WORCESTER. Onklaarberg *Stokoe* PRE.

Without locality:—*Drege* (*Didaste pentandra*) BM.G.K.TCD; *Montini* S.

4. **A. microphylla** Adamson sp. nov.

Lignosa prostrata ramosa. Folia parva nigrescentia congesta ovata petiolata. Flores parvi foliis aequilongi vel paulo longiores. Pedunculi perigonio duplo vel triplo longiores. Perigonii segmenta albomarginata, acuta vel mucronata. Stamina 8—10. Fructus compressus perigonio brevior.

Blackish green in compact flat patches. Stems woody, with many short leafy branches. Leaves crowded, dark coloured, 4—6 mm. long, 1—2 mm. wide, elliptical-ovate, acute, at the base narrowed to a petiole as long as the blade. Flowers small, on peduncles 4—6 mm. long. Perianth segments 2—3 mm. long, smooth on the back, acute or mucronate, with membranous edges. Stamens 8—10, usually in pairs. Stigmas rather long.

The type is *Compton* 7988 NBG.

Rocks on mountain summits.

Patches 20—40 cm. across, the stems horizontal, stout, woody. Hitherto confused with *A. humifusa* but differing in the much darker colour, more woody stems, small petiolate leaves, much smaller pedunculate flowers, and the perianth segments smooth on the back.

CLANWILLIAM. Krakadouw Pk. *Bolus* 26386 BOL: Boontjes Vlei *Stokoe* SAM.

CERES. Tafelberg *Compton* 10083 NBG: Gydoberg *Schlechter* 10236 BM.G.K.S.

WORCESTER. Waaihoek Pk. *Barnard* 731 SAM: *Esterhuysen* 15123, 22226, 22584 BOL; Mt. Brodie *Esterhuysen* 8442 BOL: Matroosberg *Esterhuysen* 14215 BOL: *Guthrie* 3958 BOL: Stettynsberg *Esterhuysen* 11065 BOL: Buffelshoek Pk. *Esterhuysen* 24070 BOL.

LAINGSBURG. Witteberg *Compton* 7988 NBG.

MONTAGU. Eendragt *Compton* 18411 NBG.

5. **A. teretifolia** Ecklon & Zeyher Enum. 328. 1837.

Aizoon teretifolium Dietr. Syn. Pl. 3: 130. 1847.

Green or brownish, sprawling or less often semierect. Stems woody at the base only, up to 80 cm. long, with internodes 0·5—3 cm. long, the younger terete. Leaves linear, cylindrical or sulcate above especially when dry, straight or curved, 1—2 cm. long, often secund, with an outwardly bent mucro at the tip, often with axillary fascicles of smaller leaves. Peduncles 0·5—1·5 cm. long, ascending, spreading or partly deflexed at the fruiting stage. Perianth 0·4—0·8 cm. long, the lobes acute with membranous edges, narrow on the outer, broad on the inner. Stamens numerous, 25 or more, uniformly arranged, not in groups: filaments dark coloured: anthers white. Fruit rounded, shorter than the perianth. Seeds dark brown, rugose.

The type is *Ecklon & Zeyher* 2148 B(lost), cotype S.

Sandy or stony flats and lower slopes in the south-west Cape.

Plants green or brown, very variable in size, habit, the amount of branching, the length of the internodes, and the length and thickness of the leaves. The more extreme forms are connected by all stages of intermediate.

TULBAGH. Tulbagh *Ecklon & Zeyher* S: Roodesandberg *Compton* 6623 BOL.NBG: Sevenfountains *MacOwan* 3057 SAM.

PAARL. Paarl *Alexander* K: Paarl Mt. *Compton* 22945 BOL.NBG: *Drege* S: Franschhoek Pass *Acock* 3852 S: *Compton* 20202, 21901 NBG: Wemmershoek Pk. *Esterhuysen* 11270 BOL.

STELLENBOSCH. Stickland *Acock* 1299 S: Duivelsbosch *Bowie* K.

MALMESBURY. Hopefield *Compton* 18917 NBG: *Leighton* 2458 BOL.PRE.

CAPE. Doornhoogte *Ecklon & Zeyher* 78 S: Melkbosch *Adamson* 4678: *Olivier* KIR: Cape Town *Worsdell* K: Platteklip *Giffen* CT: Muizenberg Mt. *Adamson* 1277 CT: *Bolus* 368 BM.BOL.K.S.SAM: *Guthrie* 939 CT: *Prior* K: Steenberg *Compton* 17868 NBG, 13804 NBG.PRE: *Esterhuysen* 15836 BOL: *Lewis* 1803 SAM: *Wolley-Dod* 3581 BM.BOL.K: Fishhoek *Bolus* 4851 BOL.

CALEDON. Sir Lowry Pass *Hafstrom* S: Highlands *Compton* 12338 BOL.NBG: Houwhoek *Adamson* 4425: *Bolus* 9871 BOL: *Guthrie* NBG: *Schlechter* 7358 BM.BOL.G.K.S.SAM: Caledon *Bolus* 9903 BOL.K: Swartberg *Ecklon* S: *Harvey* TCD: *Zeyher* 2148 S.SAM.TCD: Zondagskloof *Compton* 10259 NBG: Babylons Tower *Ecklon & Zeyher* 52.8 S: Onrust *Esterhuysen* 19263 BOL.

BREDASDORP. Elim *Levyns* 8434 CT: Baardscheersbosch *Stokoe* SAM: Brandfontein *Esterhuysen* 19111 BOL.

Without locality:—*Drege* (*Didaste icosandra*) BM.G.K.TCD, do (*Didaste teretifolia*) K.S.: *Gillett* 66 K: *Harvey* K.

THE SOUTH AFRICAN SPECIES OF AIZOACEAE

VII. *AIZOON*

by

R. S. Adamson.

AIZOON

The genus *Aizoon* L. contains about 25 species and has a wide but discontinuous range. It occurs in three separated areas. Of these the first which contains the largest number of species and is the one dealt with here, is in southern Africa extending from southern Angola through the western districts and along the south and east coasts. It reaches its northern limit in Portuguese East Africa. There is a record of one species in Tanganyika but there is doubt whether it is really indigenous there. The second area is in Africa north of the Sahara extending through the Middle East to Persia and N.W. India. This area also extends to the Atlantic Islands, Madeira and the Canaries, and one species occurs in Europe in southern Spain and Sicily. This northern area has its southern limits at Cape Verde on the west and Socotra on the east. The third area is Australia. No species occur in common between Australia and either of the other areas. One species, *A. canariense* L., occurs in both the northern and southern areas in Africa. All the others are restricted to one or the other.

In founding the genus Linnaeus described three species. In this account fifteen species are recognised for the southern Africa area of distribution.

AIZOON

L. Sp. Pl. 488. 1753; Gen. Pl. ed. 5. 216. 1754.

Veslingia Moench Meth. Pl. Supp. 299. 1802.

Gunniopsis Pax Engl. & Prantl Nat. Pflzf. 1. ed. 3. 1.b: 44. 1889.

Aizoanthemum Dinter ex Friedr. Mitt. Bot. Munch. 17—18: 3422. 1957.

Perennial or annual herbs, less often shrublets, often partly succulent. Leaves exstipulate, opposite or alternate. Flowers in cymose groups, often in forks of the stem, sessile or shortly stalked. Perianth segments 4 or 5, united at the base. Stamens numerous, attached to the lower part of the perianth, sometimes in groups, sometimes in 2 or more rows. Ovary superior, 4, 5, 7 or 10 chambered, often flattened and wider than

deep: ovules 2—many in each chamber: stigmas as many as the chambers, rather thick. Fruit dry, splitting at the top by as many slits as there are chambers. Seeds pear-shaped or reniform, usually slightly compressed.

The type species is *A. canariense* L.

Low growing drought-resistant plants characteristic of open ground especially in the drier areas. Flowers yellow, less often white or pink.

The species fall into three subgenera which have been looked upon as separate genera. The Australian species belong to the subgenus *Gunniopsis* Pax & Hoffm. Engl. & Prantl Nat. Pflzf. ed. 2. 16c: 223. 1934 which is readily characterised by 4-merous flowers and fruits splitting into 8 valves. The African species are in two subgenera, *Aizoon* and *Aizoanthemum*, both of which occur in both the areas of distribution.

Key to the Subgenera.

1. Flowers 5-merous: carpels 5, 7 or 10: fruit with as many valves as carpels.
  - 2. Hairy: carpels 5: filaments filiform: fruit valves not spreading, not hygroscopic .. .. 1. *Aizoon*
  - *2.* Papulose: carpels 5, 7 or 10: filaments flattened: fruit valves spreading, hygroscopic .. .. 2. *Aizoanthemum*

(*1.* Flowers 4-merous: carpels 4: fruit with twice as many valves as carpels. Australia. .. .. 3. *Gunniopsis*)

Subgen. 1. *Aizoon*.

Perennials or less often annual, covered with hairs. Flowers either solitary among the leaves or in the forks of a cymose inflorescence, 5-merous. Stamens with filiform filaments. Fruit splitting to form 5 valves which remain incurved and often attached at the tip. The valves not hygroscopic.

Key to the Species.

1. Flowers among the leaves apparently lateral.
  - 2. Stems prostrate, usually elongated.
    - 3. Stem and leaves with spreading hairs.
      - 4. Hairs scattered, rather stiff: flowers crowded: perianth incurved: fruit red .. .. .. 1. *canariense*
      - *4.* Hairs dense, fine: flowers usually solitary.
        - 5. Hairs all spreading, especially on the perianth: perianth spreading: fruit pale 2. *glinoides*
        - *5.* Some hairs spreading, some appressed: perianth with appressed hairs .. .. 3. *rigidum* var. *villosum*
    - *3.* Stem and leaves with appressed silvery hairs.
      - 6. Leaves alternate, narrowed to the base or petiolate: perianth segments acute or acuminate .. .. 3. *rigidum*
      - *6.* Leaves opposite, sessile: perianth segments more or less obtuse .. .. 4. *Zeyheri*
  - *2.* Stems erect or with erect branches.
    - 7. Stems short, woody with short branches at or close to ground level.
      - 8. Young stems and leaves densely covered with coarse appressed hairs: flowers crowded .. 5. *Burchellii*

8. Young stems and leaves thinly covered with short coarse appressed hairs: flowers not crowded.
9. Leaves involute, subulate, often pungent: perianth segments united for half their length .. .. 6. *asbestinum*
9. Leaves flat or partly folded: perianth segments united at the base only .. .. 7. *karooicum*
7. Stem and branches elongated, erect, virgate.
10. Stems all woody: young parts covered with coarse appressed hairs: leaves less than 2 cm. long: flowers mostly solitary .. .. .. 8. *Schellenbergii*
10. Flowering stems herbaceous: young parts covered with fine appressed hairs, the older glabrescent: leaves over 3 cm. long: flowers in groups .. .. 9. *virgatum*
1. Flowers terminal or in the forks of the stem: plants mostly prostrate.
11. Leaves flat: flowers many in a terminal inflorescence 10. *paniculatum*
11. Leaves terete: flowers solitary or in groups of three .. 11. *sarmentosum*

1. **A. canariense** L. Sp. Pl. 488. 1753.

A. procumbens Crantz Inst. 1: 135. 1766.

Glinus procumbens Forsk. Descr. 25. t.14. 1775.

Veslingia cauliflora Moench. Meth. Pl. Supp. 299. 1802.

Prostrate, rather thinly covered with stiff spreading hairs especially on the young parts and flowers. Stems stout, pale-coloured, branching, from very short to 30 cm. long, usually with some scales in addition to the hairs. Leaves alternate, finely papulose, oblong obovate or spatulate, occasionally subrotund, at the base narrowed to a petiole as long as or longer than the blade, at the tip obtuse or subobtuse. Leaves 1—5 cm. long, 0·4—1·5 cm. wide. Flowers sessile on the main stem and branches, often numerous and contiguous, dull yellow-green. Perianth segments with stiff spreading hairs outside, rather thin, triangular-acute, about 3 mm. long, usually incurved. Stigmas short. Fruit usually red, 5-angled, 0·3—0·6 cm. diam., depressed on top, the valves incurved and attached at the tip. Seeds compressed, dark brown, marked by acute concentric ridges.

The type is in herb. *Linn.* (650: 1).

Open ground in the drier parts of the coastal belt and on the western karoo. Frequent on disturbed ground and probably not truly indigenous in some of its stations.

While generally growing as an annual it can perennate and sometimes forms large patches. The leaves are flat on the ground. In fruit the outer edges of the valves curl upwards to allow escape of the seeds.

A very variable species in size, the amount of branching, the size of the leaves, and the quantity of hairs, especially in relation to habitat. Plants from the karoo often have very small narrow leaves, while those from moister stations may have much larger leaves and very few hairs.

Var. *denudata* Sond. Fl. Cap. 2: 469. 1862, which was based on *Ecklon & Zeyher* 2128, is not more than an extreme form from a sheltered habitat. Both in leaf-size and hairiness there are all stages of transition. Plants from Natal are large, with large leaves up to 5 cm. long and 2 cm. wide. There are all stages of intermediates.

The species is distinguished from all others by the petiolate papulose leaves with scattered spreading hairs, the crowded flowers, and the broad thin more or less incurved perianth lobes.

S.W.A. Aus *Dinter* 949 Z: Kl. Karas *Dinter* 4742 BOL.G.PRE.Z.

CAPE.

NAMAQUALAND. Zadies *Schlechter* 75 BOL.K. s.n. BM.K.S: Spektakel *Compton* 11417 KIR: *Maguire* 387 KIR: *Johnson* 307 BOL: Brakfontein *Ecklon & Zeyher* 2128 BOL.S: Ratelkraal *Maguire* 323 KIR: Blaustasie *Compton* 17223 KIR: Wallekraal *Pillans* BOL: Klipfontein *Bolus* 9531 BOL: *Zeyher* BOL: Garies *Adamson* 5010: *Esterhuysen* 1413 BOL: Bitterfontein *Compton* 11053 KIR.

VAN RHYNSDORP. Nieuwerust *Adamson* 4988: Van Rhynsdorp *Adamson* 4535.

CLANWILLIAM. Clanwilliam *Schlechter* 8593 BM.BOL.G.K.S: Pakhuis *Adamson* 4518: Grays Pass *Adamson* 4474.

GORDONIA. Keimoes *Barnard* SAM: Putzies *Adamson* 2061.

KENHARDT. Jagbult *Acocks* 12660 PRE.

SUTHERLAND. Roggeveld *Rehmann* 3197 Z.

ABERDEEN. Fair View *Meyer* 3 PRE.

MIDDELBURG. Middelburg *Marloth* 4104 PRE.

SOMERSET EAST. Bruintjeshoogte *Burchell* 3103 K.

UITENHAGE. Sundays Riv. *Burchell* 2865 K.

ALBANY. Port Alfred *Esterhuysen* 15145 BOL: *Tyson* 2 SAM.

PORT ST. JOHNS. Port St. Johns *Moss* 4373 BM.

NATAL.

PONDOLAND. Umzimklova *Jacottet* 24 Z.

PT. SHEPSTONE. Uvongo *Mogg* 13215 K.PRE.

UMZINTO. Dumisa *Rudatis* 1933 G.Z: Samvoti *King* 130 PRE.

PINETOWN. Pinetown *Wood* 533 BM.BOL. s.n. SAM.

DURBAN. Durban *Laverey* BOL: *Pillans* SAM: *Sanderson* S.TCD: *Schlechter* 2819 BM.BOL.G.K: s.n. SAM: Bluff *Leuring* BOL.

INANDA. Inanda *Wood* 681 K.

PIETERMARITZBURG. P.M.B. *Rehmann* 7522 Z: Umgeni *Rehmann* 8753, 8754 Z.

HLATISA. Hlukluwe *Wood* 2140 PRE.

WEENEN. Blaauwkrantz *Acocks* 9914 PRE.

UMVOTI. Mudin *West* 1235 PRE.

KLIP RIV. Van Reenen *Wood* G: Palmiet *Wood* G.

MGANDULI. Zinggob *Pegler* 2041 BOL.PRE.

? ? . "Chakas Kraal" *Gerstner* 2420 PRE.

TRANSVAAL. Houtbosch *Rehmann* 5907 Z: Zoutpansberg *Pole Evans* 3970 PRE.

Without locality:—*Ecklon & Zeyher* 2.9 Z: *Zeyher* 718 BM.G. Also in Portuguese East Africa and Tanganyika, "Karoo Region" *Holland* BOL. In the Atlantic Is., N. Africa, the Middle East, southern Arabia to Baluchistan. In Africa as far south as Eritrea.

2. **A. glinoides** L.f. Supp. Pl. 261. 1781.

A. hirsutum E. & Z. Enum. 325. 1837.

A green or grey-green softly hairy prostrate herb with branches in one plane. Covered all over or on the young parts with fine rather long spreading hairs. Stems 15—60 cm. long, the branches alternate. Leaves alternate, rather variable in size and shape, obovate, spatulate or subrotund, 1·5—5 cm. long, 0·5—1·5 cm. wide, finely papulose, densely hairy when young but partly glabrescent, at the tip obtuse cuspidate or acute, at the base narrowed to a petiole usually shorter than the blade. Flowers solitary, bright yellow. Perianth segments 0·3—0·8 cm. long, the outer acute or acuminate, the inner wider, mucronate, wide-spreading at anthesis, densely clothed with spreading hairs outside at least on the midrib. Fruit depressed-pentagonal, smooth, pale-coloured, 0·3—0·9 cm. diam. Seeds black, marked by rather fine concentric ridges often broken or replaced by dots in the central part.

The type is in herb. *Thunberg* U.

Rather dry open places in the eastern Cape.

Variable in size and in the quantity of hairs. Hairs white, grey or occasionally yellow. There are two forms separable on the size of the flowers and fruit though they are connected by intermediates. The commoner form has perianth segments 5—8 mm. long and fruits 6—8 mm. diam. The other has more numerous smaller flowers with perianth segments 3—5 mm. long, and fruits 3—6 mm. diam.

The species is distinguished by the prostrate habit, the long spreading hairs, the bright yellow flowers with wide-spreading perianth segments, and the smooth pale-coloured fruits.

WILLOWMORE. Willowmore *Lloyd* PRE.

ABERDEEN. Aberdeen Rd. *Pole Evans* 2542 K.PRE.

MURRAYSBURG. Murraysburg *Tyson* 301 SAM.

GRAAF-REINET. Graaf-Reinet *Adamson* 5204: *Bolus* 277, 435 BOL: *Henrici* 5018 PRE: *MacOwan* 277 TCD.

CRADOCK. E. of Cradock *Adamson* 5285: *Bolus* BOL: *Brynard* 261

PRE: *Dyer* 2129 PRE: *Marloth* 6852 PRE: Reyners Kop *Acocks* 11925 PRE: Lake Arthur *N. Rogers* K: Mortimer *Kensit* BOL.

SOMERSET EAST. Somerset East *MacOwan* Z.

SWELLENDAM. Slang Riv. *Adamson* 3818, 4612.

HUMANSDORP. Jeffreys Bay *Hutchinson* 1448 BOL.K: Gamtoos Riv. *Drege* S: *Martin* 652 KIR: Hankey *Fourcade* 2272, 3646 BOL.K.

UITENHAGE. Uitenhage *Ecklon* 189 TCD, s.n. S: *Ecklon & Zeyher* 259 BM.K.OXF.TCD: *Prior* K: *Schlechter* 2561 G.Z: Swartkops *Ecklon & Zeyher* 2131 G.K.OXF.S, s.n. S: *Ecklon* 259 BOL.S: *Drege* Z: Coega *Zeyher* Z: Enon *Thode* A2662 K.

PORT ELIZABETH. P.E. *Forbes* K: *Paterson* 1061 Z: *Paterson* 644 PRE.

ALEXANDRIA. Debega valley *Galpin* 10823 K: Frasers Camp *Compton* 19109 KIR: Nomago *Acocks* 12787 PRE: *Story* 1301 BOL.PRE: Alexandria *Esterhuysen* 15145 BOL: rd. to Grahamstown *Bolus* 1910 BOL.

ALBANY. Grahamstown *Adamson* 5270: *Bolton* S.TCD: *Dyer* 1662 K.PRE, 1663 K: *Ecklon* S: *Galpin* 13243 K: *Marloth* 10873 PRE: *Penther* 1806 S: *Rennie* 78 CT: *Rogers* 16649 Z, 27341 BOL.SAM, 35632 Z. Hounslow *Galpin* BOL: Bothas Hill *Dyer* 1437 PRE: West Hill *Adamson* 4764: Cradock Rd. *Dyer* 2129 K: Manley Flats *Compton* 19087 KIR: Alicedale *Rogers* 12030 K: Port Alfred *MacOwan* 445 TCD: Fish Riv. *Ecklon & Zeyher* 2130 BOL.K.OXF.S.TCD: s.l. *Bolus* 13281 BM: *Bowie* BM: *Gill* 43 PRE.

KEISKAMA. Boma Pass *Acocks* 9103 PRE.

BEDFORD. Bedford *Theron* 420 PRE, 1812 K.PRE.

FORT BEAUFORT. Katberg *Ecklon & Zeyher* 11.12 S.

VICTORIA EAST. Alice *Barker* 2101 KIR: Breakfast Vlei *Barker* 2840 KIR.

STOCKENSTROOM. Seymore *Scully* 47 SAM.

KING WILLIAM'S TOWN. K.W.T. *Comins* 1584 PRE: *Schlechter* 6125 K.Z: *Tyson* 976 BOL.SAM: rd. to Grahamstown *Adamson* 5270.

EAST LONDON. East London *O. Kuntze* K.

KOMGHA. Komgha *Flanagan* 120 PRE.SAM.

"British Kaffraria" *Cooper* 174 BM.BOL.K.TCD.Z.

NATAL. Isipingo *Ward* 380 PRE: Mkuzi *Johnson* 72 KIR.

Without locality:—*Drege A. glinoides* (*a*) G.K., *do.* (*b*) BM.K.OXF: *Niven* 17 BM: *Masson* BM: *Sparmann* S: *Thunberg* S: "Hort. Kew" BM:

3. **A. rigidum** L.f. Supp. Pl. 261. 1781.

White or grey, woody, prostrate, with or without short ascending branches, covered with short appressed hairs with some longer spreading

ones on the younger parts. Stems on or in the ground, 8—15 cm. long, the branches 2—5 cm. long. Leaves alternate, often crowded, secund, obovate or spatulate, acute or apiculate, narrowed at the base to a short petiole. Leaves 0·5—1·5 cm. long, 0·3—0·8 cm. wide, flat or concave above, densely covered with short closely appressed hairs. Flowers solitary, on the upper parts of the stems. Perianth segments 5—6 mm. long, acute, externally covered with appressed hairs like those on the leaves. Fruit rounded-pentagonal, sharply angled on the upper edges, 4 mm. diam.

The type is in herb. *Thunberg* U.

Sand or gravel, mostly near the sea. on the central southern coast belt.

Var. *rigidum.*

MOSSEL BAY. Gouritz Riv. *Ecklon & Zeyher* 99.12 S.TCD: *Zeyher* TCD.

HUMANSDORP. Jeffreys Bay *Fourcade* 3282 BOL.

UITENHAGE. Uitenhage *Ecklon* BOL: *Zeyher* 412 BM.K.TCD: Swartkops *Lynes* BM: Addo Bush *Hafstrom & Lindberg* S: Aloes *J. L. Drege* 8048 BOL.

PORT ELIZABETH. P. E. *Baur* 997 K: *Lardley* Z: *Muir* 4040 K: *Hafstrom & Lindberg* S: Redhouse *Hafstrom* S: *Mogg* 4723 PRE: *Paterson* 1061 BOL.Z: Cape Recife *Compton* 13150 KIR: *Holland* 3705 BOL: *Zeyher* 634 SAM: Humewood *Pillans* BOL.

ALEXANDRIA. Paterson *Johnson* 1007 PRE.

ALBANY. Despatch *Holland* 419 BOL.SAM: Port Alfred *Britten* 1899 PRE.

Without locality:—*Thunberg* S: *Verreaux* TCD: *Zeyher* 237 G.

An unnumbered specimen collected by *Ecklon*, S, has been labelled "Caledon district".

Var. *villosum* Adamson var. nov.

A typo differt foliis caulibus juvenilibusque pilis longis patentibus et subappressis dense obtectis, foliis saepe congestis.

Not silvery. Young stems and leaves densely covered with rather long spreading and very loosely appressed hairs. Leaves generally crowded. Perianth with appressed hairs.

The type is *Zeyher* 2634 S.

In similar situations and often associated with var. *rigidum.*

PORT ELIZABETH. P. E. *Fries* 3199 S: Amsterdamvlakte *Zeyher* 2634 S.

ALEXANDRIA. Kolsand *Johnson* 1046 PRE.

ALBANY. Port Alfred *Burchell* 3782 K: *Rogers* 28053 K.SAM: *Salisbury* 181 PRE.

EAST LONDON. East London *Mason* K.

SOMERSET EAST. Somerset East *Acocks* 15739 PRE.

Without locality:—*Drege* (*A. rigidum*) S.

Var. *angustifolium* Sond. Fl. Cap. 2: 470. 1862.

A. argenteum Ecklon & Zeyher Enum. 325. 1837.

More slender and without ascending branches. Stems herbaceous. Young parts and leaves silvery with long appressed hairs and very few spreading ones. Flowers larger, opening quite flat. Perianth segments 5—8 mm. long, spreading, usually acuminate. Fruit smoothly rounded at the upper edges.

The type is *Ecklon & Zeyher* 2129 B (lost) cotype S.

Sand mostly by the coast.

CALEDON. Danger Point *Compton* 10220 KIR.

BREDASDORP. Bontebok Park *Compton* 22167 KIR: Struys Bay *Esterhuysen* 4425 BOL.

SWELLENDAM. Port Beaufort *Adamson* 3814, 4614: *Walgate* 821 KIR: Dipka *Zeyher* SAM.

RIVERSDALE. Elands Kop *Muir* 1780 PRE.

MOSSEL BAY. Gouritz Riv. *Ecklon & Zeyher* 2127 BOL.OXF.S: Kruidfontein *Pole Evans* 26 PRE.

UITENHAGE. Uitenhage *Ecklon* S: Coega *Compton* 19653 BOL: *Zeyher* 2643b S.

PORT ELIZABETH. P. E. *Fries, Norlindh & Weimarck* 37 BOL: *Hafstrom* S: *Martin* 141 KIR: *West* 98 K: Cape Recife *Ecklon* OXF.S: *Ecklon & Zeyher* 2122 S, 2129 BOL.S.

ALEXANDRIA. Bokness Strand *Johnson* 935 PRE.

ALBANY. Port Alfred *Fletcher* 6 PRE: *Schonland* 1536 Z.

EAST LONDON. Kaysers Beach *Galpin* 9730 K: *Nanni* 141 PRE.

Without locality:—*Drege* (*A. rigidum* (b)) G.S., *do.* (*A. sericeum*) S: *Masson* BM.

A. glinoides × *rigidum.*

Plants intermediate between the supposed parents and found growing in association with them are referred to this hybrid. Of the varieties of *A. rigidum* taking part, var. *angustifolium* appears to be the most frequent.

GRAAF-REINET. Graaf-Reinet *Codd* 2526 PRE.

PORT ELIZABETH. P. E. *Salter* 372 1 BM: *Wilms* 2432 BM.

ALEXANDRIA. Bushmans Riv. *Archibald* 5302 PRE.

ALBANY. Port Alfred *Bolus* BOL: Kowie West *Tyson* BOL.

EAST LONDON. Gonubie Mouth *Acocks* 9136 K.PRE: East London *Galpin* 1839 BOL.PRE.

4. **A. Zeyheri** Sond. Fl. Cap. 2: 470. 1862.

White, prostrate, with ascending branches. Covered all over with rather coarse closely appressed hairs, those on the stem pointing downwards. Stems woody. Leaves opposite, rather thick, sessile, 4—6 mm. long, 2—3 mm. wide, flat or more often concave above, on the young shoots separated by internodes 2—5 mm. long. Flowers small. Perianth segments about 2 mm. long, rounded, more or less obtuse, covered outside with appressed hairs. Fruit papulose, as deep as wide.

The type is *Zeyher* 717 S.

Among rocks on the Karoo. Rare and seldom collected.

A very distinctive species with small opposite sessile leaves, and small flowers.

NAMAQUALAND. Bitterfontein *Zeyher* 717 BOL.CGE.G.K.S.SAM. TCD.

WILLOWMORE. Willowmore *Acocks* 18404 PRE.

5. **A. Burchellii** N.E.Br. Kew Bull. 1908. 290.

In low tufts or bunches. Stems woody, up to 4 cm. diam., fluted, sometimes twisted or flattened, with many branches at or shortly above ground level. Branches ascending or horizontal, up to 8 cm. long. The younger parts and leaves densely covered with rather coarse appressed or occasionally spreading hairs. Leaves crowded at the branch tips, erect, secund, 1—2 cm. long, 0·3—0·4 cm. wide, narrowly elliptical or lanceolate, flat or more commonly folded upwards, the tips acute. Hairs on the leaves ascending but sometimes reflexed on the upper side and near the base. Flowers yellow, sessile, solitary but often crowded and contiguous on the branches. Perianth segments 4—6 mm. long, densely hairy outside. Stamens about 12. Stigmas 5. Fruit enclosed by the perianth, obconical but narrowed to the top, the valves free but bent inwards. Old fruits persistent.

The type is *Burchell* 1753 K.

Dry karroo areas in the N.W. Cape and in S.W. Africa.

The hairs are white, yellowish, tawny or rusty brown. Much eaten down by sheep and goats and often much deformed and appearing as a tuft with very short branches. Readily distinguished by the habit, the dense covering of appressed hairs and the crowded flowers.

S.W.A. Windhoek *Dinter* 848 K: Scharfenstein *Pearson* 8592 BM.BOL.K.SAM: Awas Mts. *Pearson* 9687 BOL.K: Friedental *Dinter* 7997 BM.BOL.G.K.PRE.S: Gt. Karasberg *Pearson* 8253 K.BOL: Keetmanshoop *de Winter* 3293 PRE: Gt. Rozynbosch *Pearson* 3831 SAM.BOL: Aggenys *Pearson* 2941 BOL: Awab Riv. *Loeb* X10 K.PRE.

GORDONIA. Upington *Theron* 763 K.PRE: Kakamas *Esterhuysen* 23572 BOL.

NAMAQUALAND. Wortel *Pearson* 3616 K: Aggenys *Pearson* 2941 BOL.K.

PRIESKA. Prieska *Bryant* 290 K, J.290 BOL.K.PRE, 3290 BOL: *Moss* 11246 BM: *Story* 1121 PRE.

HERBERT. Vaal Riv. *Burchell* 1753 K.

HAY. Blaauwbosch *Wilman* BOL: Bermolli *Wilman* BOL: Walhaarkoz *Esterhuysen* 2864 BOL: Lanyon Vale *Acock* 1969 K.

BARKLY WEST. Barkly West *Esterhuysen* 2415 BOL.

6. **A. asbestinum** Schltr. J. Bot. 35: 280. 1897.

A small tufted plant thinly covered all over by short stout appressed hairs. Stems woody, 2—8 cm. high, with several short branches at the top. Leaves erect, involute rolled and apparently subulate, 1·5—2·5 cm. long, almost pungent at the tip. Hairs on the leaves reversed. Flowers sessile. Perianth 1—1·3 cm. long, covered outside with ascending coarse short hairs: segments united for about half their length, the lobes acute. Perianth with many parallel veins inside, often prominent in the older stages. Fruit 3—4 mm. diam., 5—6 mm. deep, enclosed by the lower part of the perianth.

The type is *Marloth* 2075 B (lost), cotype PRE.

Confined to dry rocky or stony slopes on the Asbestos Mts.

Allied to *A. Burchellii* but smaller, with very narrow leaves, and a thin covering of short stout hairs.

HAY. Asbestos Mts. *Marloth* 2075 PRE: Niekerks Hope *Acocks* 314 PRE: Bermolli *Wilman* BOL: Wolhaarkop *Esterhuysen* 2864 BOL.

BARKLY WEST. Lokatula *Esterhuysen* 2415 BOL.

7. **A. karooicum** Compton Trans. Roy. Soc. S. Afr. 19: 283. 1931.

Woody, in small bunches with erect or procumbent branches 5—20 cm. long. Thinly covered all over with coarse short white closely appressed hairs, the hairs mostly pointing downwards. Leaves alternate, crowded at the base but scattered above, elliptical-lanceolate, flat but most often folded or rolled upwards, 1·5—3 cm. long, 0·3—0·5 cm. wide. Flowers solitary on the branches, sessile. Perianth segments 4—5 mm. long, acute or acuminate, covered outside with reversed hairs. Stamens about 20, in groups. Stigmas 5, short, erect. Fruit flattened, surrounded by the perianth.

The type is *Compton* 2966 BOL.

Sandy depressions on the southern part of the karoo.

Much eaten down by sheep and goats and often reduced to small tufts without branches. Stems and leaves purplish under the hairs. Hairs never continuous and sometimes widely scattered. In undamaged plants the inflorescence is monochasial. Similar to *A. Burchellii* in general

habit but smaller and always with scattered hairs. The flowers are larger and less crowded.

ROBERTSON. Robertson Karoo *Levyns* 4348 CT: *Schmidt* 28 PRE: MacGregor *v. Niekerk* 377 BOL.

HEIDELBURG. Lemoenshoek *Adamson* 4595: Muiskraal *Adamson* 4601.

LAINGSBURG. Whitehill *Compton* 2966 BOL, 10859 KIR.

CALITZDORP. Calitzdorp *Compton* 8668 KIR.

"Karoo between Uitenhage & Albany" *Bowie* BM.

8. **A. Schellenbergii** Adamson nom. nov.

A. fruticosum Schellenb. Bot. Jahr. 48: 502. 1913 *non* L.f.

A grey or white rigid woody erect or sprawling shrublet. Stems 15—40 cm. high with ascending branches. Young part and leaves covered with rather short coarse white appressed hairs. Older stems glabrescent, pale-coloured and often pruinose. Leaves small, alternate, mostly on short shoots. Leaves oblong or obovate, 0·5—1·5 cm. long, 0·3—0·6 cm. wide, flat but usually folded upwards, acute at the tip, at the base narrowed to a short petiole. Flowers small, solitary but apparently grouped on the short shoots. Perianth 3—6 mm. long, covered outside with scattered appressed hairs, the segments acuminate, united at the base only. Stamens numerous. Stigmas 5. Fruit obovoid, much longer than wide, rounded or slightly lobed at the top.

The type is *Dinter* 887 Z.

Dry stony slopes and river beds in S.W. Africa and the N.W. Cape.

Very distinctive in habit. Much eaten by sheep and goats and often much modified in form. The hairs on the leaves are often reversed on the lower surface.

S.W.A. Tsumale *Dinter* 887 Z: Auasberg *Dinter* 3487 BM.BOL.K. PRE: Karibib *Dinter* 6896 BM.BOL.G.K.S.Z: Ganus *Pearson* 4484 K: Sabiesis *Pearson* 4108 K: Sandverhaar *Pearson* 4633 BOL.K.SAM: Kl. Karas *Dinter* 5102 BOL.K.PRE: Keetmanshoop *Liebenberg* 5170 K.PRE: *Pearson* 4348 BOL.K: *de Winter* 3264 K.PRE: Warmbad *Pearson* 4298 BOL.K: s.l. *Frick* 346a Z.

GORDONIA. Upington *Pole Evans* 2196 BOL.PRE.

KENHARDT. Kenhardt *Esterhuysen* 4002 BOL: Jagbult *Acocks* 12613 K.PRE: Marydale *Codd* 1214 PRE: *Story* 1094 PRE.

HERBERT. Katloni *Brueckner* 668 K.

HAY. Lanyon Vale *Acocks* 1954 BOL.PRE: Winstead *Acocks* 2041 PRE.

CARNARVON. Van Wyks Vlei *Acocks* 1745 PRE.

9. **A. virgatum** Welw. ex Oliv. Fl. Trop. Afr. 2: 584. 1871.

A rather slender erect shrublet with virgate almost herbaceous branches 40—90 cm. high. Shoots dying down to the base, woody at the base only. Young leaves and stems densely covered with spreading or partially appressed hairs and a few scales. Leaves alternate, 2-ranked, obovate or oblong, 3·5—5 cm. long, 1—1·7 cm. wide, obtuse or shortly apiculate, at the base gradually narrowed to a petiole. Young leaves white, the older glabrescent, the hairs appressed but spreading on the petiole. Flowers in groups on very short axillary branches, all along the shoot. Perianth segments 3—6 mm. long, united for a third their length, densely covered with appressed and spreading hairs. Filaments flattened near the base. Stigmas 5 or 4. Fruit obovoid, enclosed by the perianth. Seeds 1 or 2 in each chamber.

The type is *Welwitsch* 1113 K.

Dry rocky slopes and streambeds in the northern part of S.W. Africa and in Angola.

Very distinctive in habit and in leaf. Variable in size and in the density of the hairs in relation to habitat. In dry situations the leaves may be not more than 1·3 cm. long and 0·5 cm. wide.

S.W.A. Etosha Pan *de Winter* 2975 PRE: Otavi *Dinter* 5590 BOL. G.PRE.Z: Grootfontein *Kinges* 2864 PRE: Okahandja *Liebenberg* 5050 PRE: Okaputo *Engler* 6198 K: Lichtenstein *Dinter* 4456 S: Oliwarongo *Bradfield* 337 PRE: Karibib *Dinter* 6992 K: Auas Mts. *Boss* K: *Dinter* 3470 BOL.K.PRE: Nankloof Mts. *Rodin* 2148 BOL: *Strey* 2853 BOL.

10. **A. paniculatum** L. Sp. Pl. 488. 1753.

A. tomentosum Lam. Encyc. Meth. 3: 416. 1792.

A. stellatum Lam. l.c.

A. rarum N.E.Br. Kew Bull. 1908. 291.

A. lanceolatum Murr. Syst. Veg. ed. 8. 392. 1782.

A prostrate sprawling or semierect herbaceous perennial, the flowering shoots dying down to the base. Covered all over with white rather loosely appressed hairs, sometimes dense, sometimes lax. Stems several from the base, up to 50 cm. long, branched. Leaves opposite except in the inflorescence, crowded at the base, smaller and scattered above. Leaves oblanceolate to oblong, flat or concave above, 1·5—6 cm. long, 0·2—0·6 cm. wide, papulose, usually acute, narrowed at the base and the basal petiolate. Leaves densely hairy when young, glabrescent later especially on the upper side. Inflorescence 2—5 or more times forked, the flowers few or many, crowded or distant, with internodes between 0·5—3·5 cm. long. Flowers sessile in the forks, the bracts like leaves but smaller. Perianth 4—8 mm. long, the segments acute, red or pink, less often yellowish or cream-coloured inside, outside with few or many

spreading hairs. Stamens in bunches of 3—10: anthers dark-coloured. Fruit 4—5 mm. long, 2—3 mm. diam., enclosed by the erect perianth·

The type is in herb. *Linn.* (650: 6).

Sand at low altitudes along the western coastal belt.

Though ordinarily perennating from the base, plants often flower in the first year and in unstable habitats may behave as annuals. Variable in size, the width of the leaves, the quantity of hairs, and especially in the inflorescence. The last is often secund and flat on the ground. It may have short branches and rather crowded small flowers, 4—5 mm. across, or longer branches and few distant larger flowers, 5—8 mm. across. There are all stages of intermediate. The forms with distant larger flowers are found especially when growing among bushes. *A. rarum* N.E.Br. (type *Burchell* 1013 K) is not more than a rather extreme state of this latter form.

VAN RHYNSDORP. Giftberg *E. P. Phillips* 7501 BOL.K.SAM: Knechtsvlakte *Leipoldt* 4015 BOL: Nardouw Kloof *Stokoe* SAM.

CLANWILLIAM. Heerenlogement *Pearson* 6754 K: Zeekoe Vlei *Schlechter* 8491 BM.BOL.G.K.S.Z: Clanwilliam *Bolus* BOL: Elands Kloof *Stokoe* SAM: Duivels Kloof *Stokoe* SAM: Olifants Riv. *Schlechter* 5016 BOL.Z: *Stephens* 7174, 7301 K: Citrusdal *Herre* BOL: Modderfontein *Compton* 4287 BOL.

PIKETBERG. Piketberg *Bolus* 7544 BOL: *Edwards* 169 Z: *Esterhuysen* 23119 BOL: *Guthrie* 2612 KIR: de Hoek *Compton* 10912 KIR: Redlinghuis *Lewis* 3198 SAM.

MALMESBURY. Saldanha Bay *Ecklon* 212 S: *Ecklon & Zeyher* 2141 BOL.S: *Marloth* 7115 PRE: Hopefield *Bachmann* 852, 853 Z: *Bolus* BOL: *Letty* 3 PRE: Darling *A. L. Grant* 2547 BM: *Lewis* 1802 SAM: *Stokoe* SAM: Mamre *Adamson* 4948: *Bolus* 4278 BOL: *L. Bolus* BOL: *Compton* 13746, 17439 KIR: Ganskraal *Compton* 9448 KIR: Schaaplaats *Bachmann* 1990 Z.

TULBAGH. Nieuwekloof *Burchell* 1013 K.

STELLENBOSCH. Stellenbosch Flats *Duthie* 658 BOL: Brakenfel *Acocks* 2085, 5309 S: Bottelary *Acocks* 3344 S.

CAPE. Cape Flats *Ecklon & Zeyher* 2141 BOL.OXF.SAM: *Harvey* TCD: Milnerton *Compton* 16320 KIR: *Hutchinson* 553 BOL.K: Riet Valley *Ecklon & Zeyher* 62.11 S: Cape Town *Pappe* S: Camps Bay *Hafstrom* S: Camp Ground *Page* CT: Wynberg *Harvey* TCD: Chapmans Bay *Adamson* 2023 BOL: *Wolley-Dod* 1669 BM.BOL.K: Kommetje *Barker* 848 KIR: *L. Bolus* BOL.K: Muizenburg *Bolus* 7008 BOL: *Guthrie* 936 CT: *Marloth* 8985 PRE: Kalk Bay *Prior* K.Z: Simonstown *Ecklon & Zeyher* S: Schoesters Riv. *Salter* 270/13 BM: Witsands *Marais* CT.

Without locality:—*Auge* BM: *Burmann* G: *Drege* 7057 G.K, 7058a

G, s.n. S: *Gueinzius* S: *Lalande* BOL: *Montini* S: *Niven* BM: *Pappe* K.S: *Roxburgh* G: *Thunberg* S: *Wright* 466 TCD: *Zeyher* 393 K: "Hort. Kew" BM.

A specimen, *Bowie* BM, has been labelled in pencil "Sundays River, Uitenhage". This is almost certainly a mistake in the real locality.

11. **A. sarmentosum** L.f. Supp. Pl. 261. 1781.

Mesembryanthemum hexaphyllum Haw. Rev. Pl. Succ. 108. 1827.

A lax procumbent many-stemmed perennial with few or many branches. Stems 10—50 cm. long, woody at the base only, the younger reddish brown, with few or many appressed or spreading white hairs or scales. Leaves opposite, separated by internodes 0·5—5 cm. long. Leaves 1—4·5 cm. long, almost cylindrical, connate at the base, with few or many hairs or sometimes glabrous except for the leaf-sheath. Flowers sessile, terminal on the branches, each with a pair of leaves below, most commonly in groups of three, the lateral on branches 0·5—2 cm. long. Perianth segments 6—8 mm. long, white or cream-coloured inside, outside with white appressed hairs, the lobes acute, shortly cucullate, mucronate. Stamens in bunches of 3—8, the filaments of the bunches often united at the base. Fruit finally almost woody, turbinate, flat-topped, 0·4—0·7 cm. diam. at the top, persistent on the older stems.

The type is in herb. *Linn.* (650: 3).

Stones, gravel or rocks, usually under bushes, on the lower slopes in the S.W. Cape.

Variable in habit. Most commonly procumbent but in drier situations semierect. Internodes long or short. Glabrous or hairy with all gradations from a few scattered hairs on the young internodes and leaf bases to a dense covering all over. The more hairy forms are found especially towards the northern limits of the range and are usually much branched and more or less erect. Ecklon & Zeyher, Enum. 327. 1837, described two varieties, *strigosum* and *hirsutum*, but these do not seem more than stages in a continuous series and are not at all clearly separable. The fruit are persistent and remain attached and apparently lateral on the old stems.

NAMAQUALAND. Port Nolloth *Bolus* 9530 BOL.

PIKETBERG. Piketberg *Bolus* BOL: *Guthrie* KIR: *Schlechter* 5253 5255 Z.

TULBAGH. Tulbagh *Rehmann* 2235 Z: Waterfall *Ecklon & Zeyher* 2140 BOL.G.K: *Guthrie* 2943 KIR: *Zeyher* SAM.TCD: Tulbagh Kloof *Zeyher* S.SAM.

PAARL. Huguenot *Salter* 4667 BM.K: Agter Paarl *Barker* 339 KIR.

STELLENBOSCH. Jonkershoek *Strey* 787 PRE: Bottelary *Acock*

609 S: Firgrove *Compton* 13454 BOL.KIR: Van der Stel *C. A. Smith* 3202 PRE: Gordons Bay *Adamson* 4942: *Parker* 4116 BOL.K.KIR.

MALMESBURY. Hopefield *Bachmann* 1992 Z: Darling *Drege* S: Mamre *L. Bolus* BOL: *Zeyher* 720 BM.BOL.K.SAM: Malmesbury *Compton* 7803 KIR.

CAPE. Vissers Hoek *Compton* 13430 KIR: Melkbosch *Adamson* 4681: *Compton* 18102 KIR: Cape Flats *Bolus* 3000 BOL: *Ecklon* 2141 OXF p.pte: *Rehmann* 2143 Z: Bellville *Compton* 20753 KIR: Milnerton *Hafstrom* S: Durbanville *Adamson* 4691: Cape Town *Ecklon* S: *R. & T. Fries* 3423 S: *Harvey* TCD: *Page* BOL: *Prior* Z: *Rehmann* 1521 Z: *Worsdell* K: Sea Point *C. A. Smith* 2881 PRE: *Wilms* 3250 K: Camps Bay *Cassidy* 5 KIR: *Letty* 161 PRE: *Marloth* 1555 PRE: *Prior* K: *Salter* 270/14 BM: Bakoven *Hafstrom* S: Hout Bay *Bond* 135 KIR: Signal Hill *Adamson* 2326 BOL, 2632 CT: *Michell* CT: Lion's Head *Ecklon & Zeyher* 2140 S.TCD: *Harvey* TCD: *Kensit* CT: *Hafstrom* S: Kloof Nek *Bullock* 4026 K: *Ecklon & Zeyher* 2140 BOL.S.TCD: Table Mt. *Ecklon* 11b G.K.S: *MacOwan* 730 BM.BOL.K.PRE.SAM: s.n. G: 2494 SAM: *Stokoe* SAM: *Worsdell* K: Blinkwater *Rehmann* 1358 BM.Z: Devils Peak *Bolus* 2437 BOL: *Gerstner* 6426 PRE: *Pappe* K.S: *Tyson* 2437 BOL: *Zeyher* 720 K: Observatory *Davies* SAM: Raapenburg *Guthrie* 1168 CT: Camp Ground *Adamson* 1924: *Barker* 1041 KIR: *Cross* 43 KIR: *Isaac* BM.BOL: *Salter* 9619 BOL: Groote Schuur *Wolley-Dod* 255 BM.K: Kenilworth *Wolley-Dod* 1301 BOL: Wynberg *Drege* S: Fishhoek *Adamson* 2893: Glencairn *Compton* 4582 BOL.KIR, 11586 BOL: *Page* CT: Simonstown *Godman* 72 BM: *Harvey* TCD: *Jameson* K: Smiths Farm *Compton* 6069 KIR.

CALEDON. Pringle Bay *Gillett* 4201 PRE: Caledon *Bond* 128 KIR: *Gillett* 4255 PRE: Swartberg *Ecklon & Zeyher* 2140b TCD: Klein Riv. *Zeyher* 721 BOL.

MONTAGU. Montagu *Barnard* CT.SAM.

SWELLENDAM. Port Beaufort *Drege* S.

Without locality:—*Burchell* K: *Burmann* G: *Drege* 7056a TCD.CGE: *Harvey* TCD: *Grey* K: *Masson* 15 BM: *Miers* 357 BM: *Montini* S: *Roxburgh* BM: *Ryder* BM.K: *Sparmann* S: *Rogers* 11379 Z: *Thunberg* S: *Verreaux* G.TCD.

A. paniculatum × *sarmentosum.*

The plants referred to this presumed hybrid form a complete series between the parent species. They are found in stations where both occur. Some are like *A. paniculatum* but with very narrow leaves, others are nearer *A. sarmentosum* but with a many-flowered inflorescence. It is most probable that some of the hairy forms attributed to *A. sarmentosum* are really to be placed under this hybrid.

The following are referred here:

PIKETBERG. Kapiteins Kloof *Lewis* 3197 SAM.

MALMESBURY. Mamre *Bolus* 4279 BM: *L. Bolus* BOL: Kalabas Kraal *Hutchinson* 188 BOL.K: Moorreesburg *Esterhuysen* 23099 BOL.

PAARL. Huguenot *Salter* 4667 BOL: Wellington *Grant* 2357 K.

STELLENBOSCH. Jonkershoek *Garside* 296 K.

CAPE. Phesantekraal *v. Niekerk* 157 BOL.

Without locality:—*Drege* 7056a BOL.K.

Sub-gen. 2. *Aizoanthemum* Adamson *comb. nov.*

Dinter ex Friedr. Mitt. Bot. Munch. 17—18: 344. 1957. *pro. gen.*

Annuals without hairs but papulose all over, the papillae sometimes drawn out as flat scales. Flowers solitary, usually sessile, in the forkings of the stem. Perianth forming a cup round the ovary. Stamens often in more than one row, the filaments flat, ribbon-like, more or less dilated at the base. Ovary spherical, papulose, 5, 7 or 10-chambered. Fruit opening by as many valves as there are chambers, the valves finally spreading and more or less hygroscopic.

The type species is *A. membrum-connectens* (Dinter ex Friedr.) Adamson.

The subgenus comprises about 8 species. Those in the southern area of distribution are confined to southern Angola and the northern parts of S.W. Africa. In the northern area *A. hispanicum* L. has a wide range. It extends into Spain and Sicily on the north side of the Mediterranean. The other species are local endemics.

Aizoanthemum was first put forward as a separate genus by Dinter, Kaktnk. 1935. 2: 27, but was not given a valid description. As several of the features that are made use of for its separation are found in species belonging to subgenus *Aizoon*, it is here treated as a subgenus. The only really distinguishing characters are the absence of hairs and the spreading partly hygroscopic valves in the fruit. The very numerous stamens with flattened filaments of which the outermost in some species are without anthers, and the unequal perianth segments, suggest a possible transition to such a genus as *Cryophytum* N.E.Br.

Key to the Species.

1. Leaves opposite: coarsely papulose without scales: perianth 2—3 mm. long: filaments smooth: stigmas 5 .. .. 13. *galenioides*

1. Leaves alternate: papulose with scales: perianth over 5 mm. long: filaments denticulate.

  2. Slender: finely papulose: leaves petiolate: perianth 7—10 mm. long: stigmas 5 .. .. 12. *mossamedense*

  2. Stout: coarsely papulose: upper leaves without petioles: stigmas 7—10.

3. Erect: papulose with few scales: flowers many: perianth 5—7 mm. long: stigmas 7 .. .. 14. *Dinteri*
3. Prostrate or sprawling: papulose with many scales: flowers solitary: perianth 7—10 mm. long: stigmas 7—10 .. .. 15. *membrum-connectens*

12. **A. mossamedense** Welw. ex Oliv. Fl. Trop. Afr. 2: 584. 1871.

A rather slender brownish green annual up to 25 cm. high with spreading forked branches. Rather thinly papulose all over and with small scales on the young parts and flowers. Leaves alternate, oblong obovate or narrowly spatulate, 2—3 cm. long, 0·3—1·3 cm. wide, obtuse or subobtuse, with petioles as long as the blades. Flowers solitary in the forks of the stem, usually rather distant, bright yellow, 1—1·5 cm. across. Perianth erect, the lobes acute, the inner with membranous edges. Perianth segments united at the base only. Stamens in 2—3 rows, the filaments dark-coloured, flattened, minutely denticulate at the edges: anthers oblong, bright yellow. Stigmas 5. Fruit almost spherical, 1 cm. diam., papulose. Seeds black, reniform, with acute concentric ridges.

The type is *Welwitsch* 1264 BM.

Coastal sands in southern Angola. Not recorded elsewhere.

A distinctive species separated from others by the petiolate leaves, large flowers, and 5 carpels. It is most nearly related to *A. hispanicum* L. but is more slender, with petiolate leaves, and quite sessile flowers. Much less coarsely papulose than the other species in the subgenus.

ANGOLA. Mossamedes *Pearson* 2153 K: *Welwitsch* 1264 BM, 2380 G.K.

13. **A. galenioides** Fenzl ex Sond. Fl. Cap. 2: 469. 1862.

Aizoanthemum galenioides Friedr. Mitt. Bot. Munch. 17—18: 344. 1957.

An erect glistening coarsely papulose annual about 15 cm. high, with ascending branches. Papillae large, vesicular, not drawn out into scales. Leaves opposite, oblong or elongate-oblong, 1·5—2·5 cm. long, 0·3—0·4 cm. wide, flat or curled upwards, at the top rounded or subacute, at the base narrowed to a short petiole. Flowers small, solitary, sessile in the forks of the stem. Perianth 2—3 mm. long, the lobes erect, cucullate, densely papulose, united for about a quarter their length. Stamens with flat but smooth-edged filaments. Ovary papulose: stigmas 5.

The type is *Drege* 7060 W (lost), neotype *Dinter* 7884 M.

Rare on sand near the coast in northern S.W. Africa.

Distinguished by the coarse papillae without scales, the opposite leaves and small inconspicuous flowers. The specimens collected by Drege, which may form part of the original gathering, are less branched and have larger leaves than those of Dinter. The two are certainly con-

specific. In collections there has been some confusion due to referring to this species specimens of *Galenia Dregeana* Fenzl.

S.W.A. Swakopmund *Dinter* 7884 BM.K.S.

Without locality:—*Drege* (*A. galenioides*) S.

14. **A. Dinteri** Schinz Bull. Herb. Boiss. 6: 523. 1898.

Aizoanthemum Dinteri Friedr. Mitt. Bot. Munch. 17—18: 344. 1957.

Erect with many forking stems, 20—25 cm. high, rather coarsely papulose all over, the young parts with some scales. Older stems woody. Leaves alternate, broad-ovate oblong or rhombic, 1—5 cm. long, 0·4—2 cm. wide, rather thick, flat or curled or folded upwards, narrowed at the base to a petiole, short in the upper as long as the blade in the lower leaves. Lower leaves larger than the upper, all deciduous at or about the fruiting stage. Flowers sessile or on peduncles up to 4 mm. long, in the forks. Perianth 5—6 mm. long, papulose scaly, the segments united for about a third their length, the lobes unequal, the outer acute, the inner mucronate with a wide membranous margin. Stamens in 2—3 rows, the filaments flat, sharply denticulate at the edges, the outermost sometimes wider and without anthers. Ovary spherical, papulose; stigmas 7. Fruit 3—5 mm. diam. Seeds black, marked by acute concentric rings.

The type is *Dinter* 55 Z.

Sand at low altitudes in the northern parts of S.W. Africa.

A variable species in size, the amount of branching, and the size of the leaves. In collections Dinter has attached a number of names to specimens, e.g. *A. Bossii*, *A. sphingis*, *A. stellatum*, but pending more detailed field work all are treated as belonging to one species. In some specimens 1—3 of the perianth lobes are much elongated, 5—9 mm. The stamens may be all alike or the outermost may be without anthers and with filaments about twice as wide as the inner.

S.W.A. Etosha Pan *Brain* P. 10 PRE: *Dinter* s.n. Z: Swakopmund *Dinter* 55 Z: Ebony Stn. *Dinter* 7877 BM.K.S: Erongo Mts. *Dinter* 7077 BM.K.S: Spunzflachte *Dinter* 8455, 8456 K: Brandberg *Liebenberg* 4983 PRE: *Wiss* 1446 PRE.

15. **A. membrum-connectens** (Dinter ex Friedr.) Adamson comb. nov.

Aizoanthemum membrum-connectens (Dinter Kaktnk. 1935. 2: 27. *nomen*) Friedr. Mitt. Bot. Munch. 17—18: 345. 1957.

A stout prostrate or sprawling annual with horizontal diverging branches up to 30 cm. long. Covered all over with coarse vesicular papillae, the young parts and flowers also with scales. Leaves alternate, obovate oblong or rhombic, 1—3 cm. long, 0·5—1·2 cm. wide, flat, acute, narrowed at the base but scarcely petiolate. Flowers large, 0·8—1·2 cm. diam.,

sessile in the forks, often secund. Perianth cup-like, coarsely papulose-scaly, the segments united for about half their length, the lobes acute, erect but slightly spreading at anthesis. Stamens very numerous, in about 3 rows: filaments sharply denticulate. Ovary globose, papulose: stigmas 7—10. Fruit 6—8 mm. diam., flattened or depressed on top.

The type is *Strey* 2496 M.

Open places on sand generally near the coast in S.W. Africa.

A much larger and stouter plant than *A. Dinteri,* with much larger flowers. The stems may be as much as 1 cm. diam. at the base. The rather inadequate description of *Mesembrianthemum Rehmannii* Schinz Bull. Herb. Boiss. 5. App. 3: 80. 1897, seems to fit this species. But as neither the type nor any other specimen has been seen, it must remain uncertain. A specimen from Damaraland collected by Rehmann, in herb. Zurich, which is so named, is certainly not this species. It has long petaloid staminodes.

S.W.A. Swakopmund *Dinter* 7828 K: Rehoboth *Strey* 2148, 2496, 2604, 2643 PRE: Nankloof Mts. *Rodin* 2841 BOL: *Strey* 2138 BOL.

INDEX OF NUMBERED SPECIMENS QUOTED.

sarmentosum; 13150 *rigidum;* 13430, 13454 *sarmentosum;* 13746, 16320 *paniculatum;* 17223 *canariense;* 17439 *paniculatum;* 18102 *sarmentosum;* 19087, 19109 *glinoides;* 19653 *rigidum* v. *angustifolium;* 20753 *sarmentosum;* 22167 *rigidum* v. *angustifolium.*

COOPER. 174 *glinoides.*

CROSS. 43 *sarmentosum.*

DINTER. 55 *Dinteri;* 848 *Burchellii;* 887 *Schellenbergii;* 949 *canariense;* 3470 *virgatum;* 3487 *Schellenbergii;* 4456 *virgatum;* 4742 *canariense;* 5102 *Schellenbergii;* 5590 *Burchellii;* 6896 *Schellenbergii;* 6992 *virgatum;* 7077 *Dinteri;* 7828 *membrum-connectens;* 7877 *Dinteri;* 7884 *galenioides;* 7997 *Burchellii;* 8455, 8456 *Dinteri.*

DREGE. 1130 *paniculatum* × *sarmentosum;* 7056a *paniculatum* & *paniculatum* × *sarmentosum;* 7057, 7058a *paniculatum;* 7884 *galenioides.*

DREGE J. L. 8048 *rigidum.*

DUTHIE. 658 *paniculatum.*

DYER. 1130 *sarmentosum;* 1437, 1662, 1663, 2129 *glinoides.*

ECKLON. 11b *sarmentosum;* 189 *glinoides;* 212 *paniculatum;* 259 *glinoides;* 412 *rigidum;* 2130, 2131 *glinoides;* 2140, 2141 *sarmentosum.*

ECKLON & ZEYHER. 2.9 *canariense;* 11.12 *glinoides;* 62.11 *paniculatum;* 99.12 *rigidum;* 259 *glinoides;* 2122 *rigidum* v. *angustifolium;* 2127 *rigidum* v. *angustifolium;* 2128 *canariense;* 2129 *rigidum* v. *angustifolium;* 2130, 2131 *glinoides;* 2140, 2140b *sarmentosum;* 2141 *paniculatum* & *paniculatum* × *sarmentosum.*

EDWARDS. 169 *paniculatum.*

ENGLER. 6198 *virgatum.*

ESTERHUYSEN. 1413 *canariense;* 2415 *asbestinum;* 2864 *asbestinum;* 4002 *Schellenbergii;* 4425 *rigidum* v. *angustifolium;* 15145 *glinoides;* 23119 *paniculatum;* 23572 *Burchellii;* 23099 *paniculatum* × *sarmentosum.*

FLANAGAN. 120 *glinoides.*

FLECK. 346a *Schellenbergii.*

FLETCHER. 6 *rigidum* v. *angustifolium.*

FOURCADE. 2272 *glinoides;* 3282 *rigidum;* 3646 *glinoides.*

FRIES. 3199 *rigidum* v. *villosum;* 3423 *sarmentosum.*

FRICK. 346a *Schellenbergii.*

FRIES, NORLINDH & WEIMARCK. 37 *rigidum* v. *angustifolium.*

GALPIN. 1839 *glinoides* × *rigidum;* 9730 *rigidum* v. *angustifolium;* 10823, 13243 *glinoides.*

GARSIDE. 296 *paniculatum.*

GERSTNER. 2420 *canariense;* 6426 *sarmentosum.*

GILL. 43 *glinoides.*

GILLETT. 4201, 4225 *sarmentosum.*

GODMAN. 72 *sarmentosum.*

GRANT. 2356, 2547 *paniculatum;* 2357 *paniculatum* × *sarmentosum.*

GUTHRIE. 936 *paniculatum;* 1168 *sarmentosum;* 2612 *paniculatum;* 2943 *sarmentosum.*

HARVEY. 259 *glinoides.*

HENRICI. 5018 *glinoides.*

HERRE. S.U.G. 12930 *paniculatum.*

HOLLAND. 8 *canariense;* 419 *rigidum;* 3705 *rigidum.*

HUTCHINSON. 168 *sarmentosum;* 188 *paniculatum* × *sarmentosum;* 553 *paniculatum;* 1448 *glinoides.*

JACOTTET. 24 *canariense.*

JOHNSON. 72 *glinoides;* 307 *canariense;* 935 *rigidum* v. *angustifolium;* 1007 *rigidum;* 1046 *rigidum* v. *villosum.*

KING. 130 *canariense.*

KINGES. 2864 *virgatum.*

LEIPOLDT. 4015 *paniculatum.*

LETTY. 3 *paniculatum;* 101 *sarmentosum.*

LEVYNS. 4348 *karooicum.*

LEWIS. 1802 *paniculatum;* 3197 *paniculatum* × *sarmentosum;* 3198 *paniculatum.*

LIEBENBERG. 4983 *Dinteri;* 5050 *virgatum;* 5170 *Schellenbergii.*

LOEB. X10 *Burchellii.*

MAGUIRE. 323, 587 *canariense.*

MACOWAN. 730 *sarmentosum;* 277 *glinoides;* 445 *glinoides;* 2494 *sarmentosum.*

MARDON. 108 *canariense.*
MARLOTH. 1555 *sarmentosum;* 2075 *asbestinum;* 4104 *canariense;* 6852 *glinoides;* 7115, 8985 *paniculatum;* 10873 *glinoides.*
MARTIN. 141 *rigidum* v. *angustifolium;* 652 *glinoides.*
MASSON. 15 *sarmentosum.*
MEYER. 3 *canariense.*
MIERS. 357 *sarmentosum.*
MOGG. 1723 *rigidum;* 13215 *canariense.*
MOSS. 4373 *canariense;* 11246 *Burchellii;* 18127 *sarmentosum.*
MUIR. 4780 *rigidum* v. *angustifolium;* 4040 *rigidum.*
NANNI. 141 *rigidum* v. *angustifolium.*
v. NIEKERK. 157 *paniculatum* × *sarmentosum;* 377 *karooicum.*
NIVEN. 17 *glinoides.*
PARKER. 4116 *sarmentosum.*
PATERSON. 1061 *rigidum.* 644 *glinoides.*
PEARSON. 2153 *mossamedense;* 2941 *Burchellii;* 2831 *virgatum;* 3616, 3831 *Burchellii;* 4108, 4298, 4348, 4484, 4633 *Schellenbergii;* 5592 *Burchellii;* 6754 *paniculatum;* 8253, 8592, 9687 *Burchellii*
PEGLER. 2041 *canariense.*
PENTHER. 1806 *glinoides.*
PHILLIPS, E. P. 7501 *paniculatum.*
POLE EVANS. 26 *rigidum* v. *angustifolium;* 2196 *Schellenbergii;* 2542 *glinoides;* 3970 *canariense.*
REHMANN. 1350, 1521, 2143, 2235 *sarmentosum;* 3197 *canariense;* 5907 *canariense;* 7522, 8753-4 *canariense.*
RENNIE. 78 *glinoides.*
RODIN. 2148 *virgatum;* 2841 *membrum-connectens.*
ROGERS. 3563 *glinoides;* 11379 *sarmentosum;* 12030, 16629, 16649, 27341 *glinoides;* 28053 *rigidum* v. *villosum;* 35632 *glinoides.*
RUDATIS. 1933 *canariense.*
SALISBURY. 181 *rigidum* v. *villosum.*
SALTER. 270/13 *paniculatum;* 270/14 *sarmentosum;* 372/1 *glinoides* × *rigidum;* 4667 *sarmentosum* & *paniculatum* × *sarmentosum;* 9619 *sarmentosum.*
SCHLECHTER. 75 *canariense;* 2561 *glinoides;* 2819 *canariense;* 5016 *paniculatum;* 5331 *paniculatum;* 5253, 5255 *sarmentosum;* 6125 *glinoides;* 8491 *paniculatum;* 8593 *canariense.*
SCHMIDT. 28 *karooicum.*
SCHONLAND. 1536 *rigidum* v. *angustifolium.*
SCULLY. 47 *glinoides.*
SMITH, C. A. 2881, 3202 *sarmentosum.*
STEPHENS. 7174, 7301 *paniculatum.*
STORY. 1094 *Schellenbergii;* 1121 *Burchellii;* 1301 *glinoides.*
STREY. 787 *sarmentosum;* 2138, 2148, 2496, 2604, 2643 *membrum-connectens;* 2853 *virgatum.*
THERON. 420 *glinoides;* 763 *Burchellii;* 1812 *glinoides.*
THODE. 12662 *glinoides.*
TYSON. 2 *canariense;* 301, 976 *glinoides;* 2437 *sarmentosum.*
WALGATE. 821 *rigidum* v. *angustifolium.*
WARD. 380 *glinoides;* 2140 *canariense.*
WELWITSCH. 1113 *virgatum;* 1264, 2380 *mossamedense.*
WEST. 98 *rigidum* v. *angustifolium;* 1235 *canariense.*
WILMS. 2432 *glinoides* × *rigidum;* 3230 *sarmentosum.*
DE WINTER. 2975 *virgatum;* 3264 *Schellenbergii;* 3293 *Burchellii.*
WISS. 1446 *Dinteri.*
WOLLEY-DOD. 255, 1301 *sarmentosum;* 1669 *paniculatum.*
WOOD. 533, 681 *canariense.*
WRIGHT. 466 *paniculatum.*
ZEYHER. 99.12 *rigidum;* 237 *rigidum;* 259 *glinoides;* 393 *paniculatum;* 412 *rigidum;* 625 *paniculatum;* 634 *rigidum;* 717 *xeyheri;* 718 *canariense;* 720, 721 *sarmentosum;* 2632 *glinoides;* 2634 *rigidum* v. *villosum;* 2634b *rigidum* v. *angustifolium.*

INDEX.

THE SOUTH AFRICAN SPECIES OF AIZOACEAE

VIII. *PSAMMOTROPHA*.

By

R. S. Adamson.

PSAMMOTROPHA.

Psammotropha is a small genus almost confined to South Africa though one species occurs in Angola and in Tanganyika, and one in Portuguese East Africa. In the south the species are found on the western coastal belt and on the mountains along the south and east coasts.

The genus which is characterised by solitary basal ovules, is closely related to *Adenogramma* and *Polpoda* and with them has frequently been referred to Phytolaccaceae. The systematic position was considered under those genera. (J. S. Afr. Bot. 21: 83. 1955.)

As first created the genus comprised a single species. It was revised and given its present connotation by Fenzl in 1840 Sonder, Fl. Cap. 1: 146. 1862, described four species. The number recognised is now eleven, of which four are described for the first time.

PSAMMOTROPHA.

Ecklon & Zeyher Enum. 286. 1837. *emend.* Fenzl Ann. Wien. Mus. 2: 264. 1840.

Perennials, either small shrublets or cushion or mat plants with rosettes of leaves. Leaves alternate or less often in whorls. Stipules scarious, sometimes caducous or wanting except in the inflorescence. Flowers in cymose groups, often umbellate, either terminal or axillary, the bracts often whorled. Flowers small, bisexual, on short pedicels. Perianth segments 5, free or almost so. Stamens 5, alternate with the perianth segments, the filaments on or just outside a ring-like disc. Disk sometimes wanting. Ovary superior, 3, 4 or 5-chambered, with a single basal ovule in each chamber: stigmas as many as the chambers, free or united in a style. Fruit loculicidal. Seeds compressed, orbicular or reniform, rugose or tuberculate.

The type species is *Ps. marginata* (Thb.) Druce (*Ps. parvifolia* E. & Z.).

The floral structure is very uniform.

The stamens have often been described as united at the base but the

basal ring is better looked on as a disc. In some species it is internal to the insertion of the filaments, in others they appear as if on it.

In habit the species fall into two groups which are so distinct that they are treated as constituting separate series.

Key to the Series.

1. Shrublets or herbs with elongated stems with leaves all along: inflorescences axillary or terminal: flowers not in whorls ..	1. *Marginatae*
1. Cushion or mat herbs with short stems: leaves all or most in a tuft at or about ground level: inflorescences erect with whorled bracts and flowers	2. *Mucronatae*

Series 1. *Marginatae* Adamson ser. nov.

Herbaceae vel saepius suffruticosae caulibus elongatis foliosis. Inflorescentiae terminales vel axillares cymosae non verticillatae.

Small shrublets or perennial herbs with elongated stems with leaves all along. Inflorescences terminal or axillary, cymose, the bracts and flowers not in whorls.

The type species is *Ps. marginata* (Thunb.) Druce.

All the species in this series are confined to the south-western Cape Province.

Key to the Species.

1. Leaves separated by distinct internodes: stipules persistent.	
2. Herbaceous: leaves in whorls: inflorescence axillary ..	1. *marginata*
2. Woody: leaves alternate: inflorescence terminal.	
3. Diffuse: leaves flat: stipules small: inflorescence umbellate	2. *diffusa*
3. Erect: leaves revolute: stipules covering the internodes: inflorescence spicate	3. *spicata*
1. Leaves crowded, overlapping, covering the stem: stipules wanting.	
4. Young shoots 4-angled: inflorescence pedunculate: bracts lanceolate, aristate	4. *quadrangularis*
4. Young shoots terete: inflorescence sessile: bracts boat-shaped, acute	5. *anguina*

1. **Ps. marginata** (Thunb.) Druce Rep. Bot. Soc. Br. Is. 1916. 642. 1917.

Pharnaceum marginatum Thunb. Prod. Pl. Cap. 54. 1794.

Mollugo marginata Ser. DC. Prod. 1: 392. 1828.

Ps. parvifolia Ecklon & Zeyher Enum. 287. 1837.

A prostrate or sprawling herb with erect or ascending lateral branches. Stems slender, mostly underground, with internodes 0·4—2 cm. long, the aerial shoots up to 15 cm. long, sharply ridged, with shorter internodes. Leaves small, in whorls of 3—6, ovate-elliptical, 2—3 mm. long, acute or mucronate, aristate, with a pale-coloured slightly revolute margin. Stipules persistent, less than 1 mm. long, cut into coarse threads. Flowers

almost sessile, greenish, in groups in the upper axils. Perianth less than 1 mm. long, the segments united at the base. Stamens on a very small ring-like disc. Ovary rounded: style very short. Fruit 3-angled, wider than deep. Seeds brown, very finely rugose.

The type is in herb. *Thunberg* U. (of *Ps. parvifolia E. & Z.* 1833 B (lost) cotype S).

Sand at low altitudes in the central south coast region. Rare and not collected within recent years. Very easily overlooked.

UITENHAGE. Swartkops *Ecklon* s.n. S: *Ecklon & Zeyher* 1833 G.S.SAM.TCD: *Zeyher* 468 BOL.CGE.K.S.SAM.TCD, 2501 K.PRE.S.Z: Koussie *Drege* S.

SOMERSET EAST. Bothasberg *MacOwan* s.n. K.

Without locality:—*Garstonius* S: *Swartz* S: *Verreaux* K.

2. **Ps. diffusa** Adamson sp. nov.

Suffruticosa laxa diffusa vel decumbens. Folia alterna, linearia distantia stipulis membranaceis persistentibus acuminatis basi dilatatis. Flores terminales parvi subumbellati.

A lax diffuse or decumbent glabrous shrublet. Stems 10—30 cm. high with ascending branches, the older woody, the younger brown, ridged, with internodes as long as or longer than the leaves. Leaves linear, 3—6 mm. long, flat or concave above, acute or subacute, with a very short hair-like point. Stipules 1—1·5 mm. long, the lower part brown ovate or rotund, the upper white, linear, acuminate, the base adnate to the leaf-base and very shortly laciniate. Flowers in a terminal subumbellate group of 3—12, the branches up to 0·7 cm. long. Peduncles with stipule-like bracts, the ultimate 1—3 mm. long. Perianth segments 1 mm. long, incurved, green with a narrow white edge. Stamens on a small disc. Ovary 3-angled, rarely 2: style short, 3-fid at the top. Fruit rounded, brown, shorter than the perianth.

The type is *Esterhuysen* 18036 BOL.

A local endemic on the Cedarberg.

CLANWILLIAM. Sneeuwberg, on the shale band. *Esterhuysen* 18036 BOL.K.KIR.PRE.

3. **Ps. spicata** Adamson sp. nov.

Suffruticosa erecta ramosa. Folia alterna fasciculata revoluta aristo-mucronata stipulis magnis scariosis laxe seto-ciliatis. Flores spicati subsessiles bracteis foliosis. Perigonii segmenta obtusa subcarinata. Stigmata 3.

An erect branched woody shrublet 20—25 cm. high, the branches ascending, the younger with alternate leaves, the older with fascicles of

small leaves. Leaves 3—4 mm. long, ascending, longer than the internodes, thickened and more or less revolute at the edges, the tip aristate-mucronate. Leaves in the axillary fascicles obtuse with no hair-point. Stipules covering the internodes, half to two-thirds the length of the leaves, scarious, gradually narrowed from base to tip, often brown, loosely fringed with coarse bristles. Inflorescence terminal, spike-like, 0·5—1·5 cm. long, compact or lax below. Bracts leaf-like, the lower longer than the flowers. the upper shorter. Flowers 1—2 to each bract, sessile or nearly so. Perianth about 1 mm. long, the segments obtuse, cucullate, green with a white margin. the middle bulged outwards. Stamens on a very small disc. Stigmas 3, rather thick.

The type is *Esterhuysen* 22000 BOL.

A local endemic on sandy soils on the Giftberg.

A distinctive species which in several features seems to mark a transition to *Polpoda*. This and the previous species are very distinctive in habit but agree with the genus completely in flower structure.

VAN RHYNSDORP. Giftberg *Esterhuysen* 22000 BOL.K.

4. **Ps. quadrangularis** (L.f.) Fenzl Ann. Wien. Mus. 2: 263. 1840.

Pharnaceum quadrangulare L.f. Supp. Pl. 185. 1781.

Mollugo quadrangularis Ser. DC. Prodr. 1: 393. 1828.

An erect or diffuse shrublet 10—30 cm. high, with ascending branches, either lax or in compact bunches. The younger shoots completely covered by overlapping 4-ranked leaves which form 4 projecting angles. Leaves erect, closely appressed or slightly spreading, 2—4 mm. long, acute or acuminate, tipped by a stiff but often deciduous bristle, the margins pale-coloured, thickened and slightly revolute. Stipules wanting. Inflorescence terminal, pedunculate, cymose-umbellate, with 2—4 main branches. Flowers in groups either contiguous or distant. Peduncle 0·4—1 cm. long. Bracts like the leaves but larger, thinner, almost flat and not thickened at the edge, the midrib distinct and slightly depressed. Perianth segments about 1 mm. long. Disc wanting. Ovary 3- or 4-angled: stigmas 3 or 4. Fruit about as long as the perianth. Seeds brown, orbicular-reniform, finely tuberculate.

The type is in herb. *Linn.* (387: 7).

Sand, less often on gravel or rocks, on flats and lower mountain slopes in the south-western coastal belt and on the ranges bordering the karoo.

Pale green or somewhat glaucous, often tinged with pink, red or orange on the older parts. Variable in size and in the number and closeness of the branches, ranging from short bunched plants to lax shrublets. There is also much variation in the closeness of the leaves. On this Fenzl l.c. created two varieties: (*a*) *mucronata* with short closely appressed

leaves with short points, and (*b*) *subulifolia* with longer more spreading leaves with longer points. While the extremes undoubtedly look distinct, there are all stages of intermediate, and the differences seem largely correlated with habitat and season. Early in the season and in more sheltered localities longer and more spreading leaves are formed, while later or in more exposed places they are short and closely appressed. The type specimen is one with long rather spreading leaves.

NAMAQUALAND. Ezelfontein *Drege* S: Grasberg *Drege* S.

CLANWILLIAM. Heerenlogement *Ecklon & Zeyher* 1832 BOL. G.K.SAM.TCD: *Zeyher* 50 S: Bokwater *Acocks* 15177 PRE: Graafwater *Adamson* 4501: Matjes Riv. *Wagener* 234 KIR: Wuppertal *MacOwan* 3265 SAM: Koupoort *Esterhuysen* 12277 BOL p.pte. K.p.pte: Middelberg *Barnes* BOL: *Lewis* BOL: Tafelberg *Esterhuysen* 13038 BOL: Cedarberg *Stokoe* 7318 BOL: Elands Kloof *Lewis* BOL: Crystal Pool *Compton* 6309 KIR: Krom Riv. *Esterhuysen* 20478 BOL.

PIKETBERG. Piketberg Mt. *Bolus* 13559 BOL: 24 Rivers *Esterhuysen* 16159a, 21684 BOL.

CERES. Cold Bokkeveld *Adamson* 4294, 4727: *Marloth* 3281 PRE: Baileys Gat *Adamson* 4723: Elands Kloof *Adamson* 4718: *Compton* 10023, 16201 KIR: Winkelhaaks Riv. *Esterhuysen* 12682 BOL: Tafelberg *Esterhuysen* 20643 BOL: Wabooms Riv. *Barker* 3873 KIR: *Compton* 6518 KIR p.pte: *Schlechter* 10166 G.Z: Gydo Pass *Hafstrom & Acock* 436 S: *Leipoldt* 4008 BOL: Karoo Poort *Acocks* 1619, 3225 S: Visgat *Esterhuysen* 13454 BOL: Ceres *Bolus* 1045 BMp.pte: Laken Vlei *E. P. Phillips* 2034 SAM.

WORCESTER. Matroosberg *Marloth* 1990 PRE: Buffelshoek Pk. *Esterhuysen* 24077 BOL: Roodeberg *Esterhuysen* 20913 BOL.K: Bonteberg *Esterhuysen* 3651 BOL: de Doorns *Bolus* 13111 BOL: Worcester *v. Breda* 131, 193 BOL.PRE.

LAINGSBERG. Witteberg *Compton* 2688 BOL, 12208 BOL.KIR, s.n. BOL: Cabidu *Barker* 6166 BOL.PRE: Touws Riv. *Schimper* Z.

PRINCE ALBERT. Berzenfontein *Andreae* 1362 PRE.

LADISMITH. Anysberg *Esterhuysen* 17059a BOL.

Without locality:—*Burmann* G: *Delessert* G: *Drege* (Ph. quad. a & b) BM.BOL.G.K.S.SAM.TCD: do (Ph. subulatum) BM.G.K.S.TCD: *Ecklon & Zeyher* s.n. CGE, 137.10 Z: *Forsyth* BM: *Niven* 27 BM: *Sparmann* S: *Thunberg* BM.S: *Verreaux* G: *Zeyher* 1829 Z, s.n. K.

Var. *calcaratum* Compton J. S. Afr. Bot. 6: 59. 1940.

Leaves with short acute divaricate projections at the base, the projections about as long as the width of the leaf.

The type is *Compton* 1937 BOL.

VAN RHYNSDORP. Nardouw *Compton* 1937 BOL: 6987 KIR.

5. **Ps. anguina** Compton J. S. Afr. Bot. 6: 56. 1940.

A sprawling or semiprostrate shrublet with lax branching. Stems covered by closely appressed leaves in 4 ranks but not forming acute angles, the shoots terete or very obtusely 4-angled. Leaves 1·5—2 mm. long, acute, with or without a deciduous pair-point, the edges much thickened and partly revolute. Inflorescence terminal, corymbose, crowded, sessile or nearly so. Bracts thin, boat-shaped, concave, acute, 2—3 mm. long, longer than the pedicels, not thickened at the edges, the midrib not apparent. Perianth about 1 mm. long. Stamens short, on a very small disc. Ovary 3-angled: stigmas 3.

The type is *Compton* 4420 BOL.

Sand, especially on level areas, on the west coastal region.

Much like *Ps. quadrangularis* and frequently confused with that, but more slender, sprawling and less regularly branched, with almost terete shoots, a sessile inflorescence, and large boat-shaped bracts.

CLANWILLIAM. Koupoort *Esterhuysen* 12277 BOL.P.pte.K.p.pte. KIR: Heuning Vlei *Stokoe* SAM: Crystal Pool *Compton* 6389 BOL: Middelberg *Barnes* KIR: Uitkyk Pass *Compton* 7001 KIR: Elands Kloof *Lewis* BOL.

PIKETBERG. 24 Rivers *Esterhuysen* 21884 K.

CERES. Ceres *Adamson* 4400: *Bolus* 1045 BM.p.pte: BOL.p.pte. K.G.SAM.Z: 7348 BOL, 8618 K: *Hutchinson* 577 BOL.K.PRE: *Pillans* BOL: Ceres Pk. *Acock* S: Mostertsberg *Schlechter* 939 BM.Z: Wabooms Riv. *Compton* 6518 BOL.p.pte: *Schlechter* 10166 BOL.K.S: Waendrift Fm. *Johnson* 509 KIR: Ceres Wild Flower Show *Acocks* 3257 S: *Compton* 4420, 4885 KIR, 8566 BOL.KIR.

Series 2. *Mucronatae* Adamson ser. nov.

Herbaceae caespitosae vel pulvinatae caulibus brevibus. Folia ad apicem caulium congesta. Inflorescentiae erectae verticillatae.

Herbaceous cushion or mat plants with short stems in or on the ground. Leaves either all or most crowded in a tuft at or about ground level. Inflorescences erect, with whorls of bracts and flowers.

The type species is *Ps. mucronata* (Thunb.) Fenzl.

On mountains and higher ground in the eastern districts. One species occurs on mountain tops in the western Cape. Both the species found in the more tropical regions belong here.

KEY TO THE SPECIES.

1. Inflorescence pedunculate: leaves acute or mucronate, if obtuse petiolate.
   2. Leaves linear, not narrowed to the base, firm, the midrib projecting: bracts acute: stem thickened at the top: leaf-tufts depressed in the centre .. .. .. 6. *myriantha*

2. Leaves linear-oblong, usually narrowed to the base, thin, the midrib not projecting: bracts mucronate: stems not thicker at the top: leaf-tufts not depressed in the centre.
   3. Leaves with a thickened border.
      4. Leaves erect, aristate, 1—2 cm. long: stigmas usually 3 .. .. 7. *mucronata* var. *marginata*
      4. Leaves incurved, mucronate, 2—3 mm. long: stigmas 5: small plant in low cushions or mats 10. *frigida*
   3. Leaves not thickened but often white at the edge.
      5. Leaves linear-lanceolate, 0·5—3 cm. long, all in a tuft.
         6. Leaf-tufts compact: leaves 0·5—1 cm. long, thin, usually colourless at the base: inflorescence with few leaves .. .. 7. *mucronata* var. *mucronata*
         6. Leaf-tufts lax: leaves 2—3 cm. long, opaque, dark green to the base: inflorescence with several nodes with leaves 7. *mucronata* var. *foliosa*
      5. Leaves oblong or spatulate, 2—5 mm. long, some scattered on the stem.
         7. Leaves almost petiolate, obtuse or apiculate, scattered all along the stem .. 8. *obovata*
         7. Leaves oblong, little or not narrowed to the base, shortly mucronate, most in a tuft, a few scattered .. .. .. 9. *alternifolia*

1. Inflorescence without a peduncle, cymes axillary: leaves obtuse, 2—3 mm. long: very small creeping plant .. .. 11. *obtusa*

6. **Ps. myriantha** Sond. Fl. Cap. 1: 147. 1860.

Ps. breviscapa Burtt-Davy Man. Fl. Pl. Tvl. 1: 49. 1926.

In single or multiple tufts or small cushions. Stems erect, simple or branched, 1—8 cm. long, much widened at the top to 0·5—2 cm. diam.. Leaves densely crowded in rosettes depressed on top. Leaves spreading, ascending or incurved, 0·6—1·1 cm. long, 0·1—0·3 cm. wide, linear, strap-shaped, acute, with a terminal bristle 1—2 mm. long. Leaves parallel sided, not narrowed to the base, opaque, the midrib distinct and slightly projecting on the underside, the margins slightly thickened. Stipules caducous except on the inflorescence. Inflorescences few or many, erect, 3—30 cm. high, simple or branched, with whorled leaves and flowers. Peduncle stout, 2—10 cm. long, ending in a whorl of leaves or stipules, with 0—6 branches, the upper nodes, if branched, with 1—2 unequal branches. Whorls of leaves and flowers few or many, 0·5—1·5 cm apart below, closer above. Bract-like leaves but 2—5 mm. long, with persistent stipules about half their length. Flowers crowded, on pedicels 2—5 mm. long. Perianth segments incurved, about 1 mm. long. Stamens on a very small ring-like disc. Ovary 5-angled, less often 3: stigmas 5 or 3, spreading or recurved, often longer than the style.

The type is *Zeyher* 616 S.

Rocks or stony places on the eastern mountains and on the highveld. Also in Angola and Tanganyika.

Very variable in size, in the thickness and amount of branching of the stem, in the length and width of the leaves, and in the extent of the inflorescence. While the more extreme forms appear distinct they are connected by all stages of intermediates. Many of the variations seem directly correlated with habitat conditions. The plants segregated as *Ps. breviscapa* Burtt-Davy (type *Wood* 5728) are a form from exposed upland sites and separable only on qualitative features such as habit and size. There are all stages of transition between this and the more typical forms. No segregation of the forms is possible until a detailed experimental and cultural study of them has been undertaken.

CAPE.

SOMERSET EAST. Zuurberg *Schlechter* 657a Z.

TSOMO. Tsomo "THB" TCD.

ENGCOBO. Francis *Flanagan* 2776 PRE.

UMTATA. Bazizaberg *Baur* 613 K.

LUSIKISIKI. s.l. *Bachmann* 502 BM.Z, 500, 503 Z.

MACLEAR. Maclear *Marais* 875 PRE: Belfort *Jacottet* 407 Z.

MT. CURRIE. Mts. *Tyson* 1363 Z.p.pte.

NATAL.

UMZINTO. Dumisa *Rudatis* 459 BM, 1474 BM.G.K.S.Z.

MARITZBURG. P.M.Burg *Fairall* 145 KIR: *Mogg* 5546 PRE: *Rehmann* 7546 Z.

CAMPERDOWN. Inchanga *Forbes* 11 K.

DURBAN. Durban *Krauss* N4 BM: *Sutherland* TCD.

ESTCOURT. Hlatikulu *Killick & Marais* 2160 PRE.

UMVOTI. Greytown *Fisher* 917 PRE: *Wylie* K.

INANDA. Inanda *Wood* 1 BOL, 602 BM.BOL.SAM: Bothas *Wood* SAM.

LIONS RIV. Nottingham Rd. *Galpin* 9577 K.

KRANTZKOP. Krantzkop *Rogers* 24724 Z: "Forest Dept." K.

WEENEN. Culvers *Rogers* 28295 G.SAM.Z: Swartkop *Wood* 10102 G: Shafton *Hutton* Z.

BERGVILLE. Mt. aux Sources *Bayer & McClean* 174 PRE: Cathedral Pk. *Esterhuysen* 10224 BOL.

KLIP RIV. Van Reenen *Sutherland* S.TCD: *Wood* 572 K, 9715 BOL: Biggarsberg *Schlechter* 3402 Z, 3431 BM.G.K.S.SAM.

NONGOMA. Cwembe Hill *Gerstner* 4667 PRE: Mapamula *Gerrard & McKen* 1521 TCD.

PAULPIETERSBURG. Dumbe Mt. *Codd* 1719 PRE.
S.l. *Buchanan* 89 K: *Dunne* BM: "Zululand" *Gerrard* 1521 BM.

Orange Free State.

SMITHFIELD. Smithfield *Wood* Z.
HARRISMITH. Harrismith *Sankey* 18 K.

Transvaal.

ERMELO. Ermelo *Henrici* 1684 PRE: *Steyn* 827 KIR.

STANDERTON. Perekopberg *Rehmann* 6834 Z: Standerton *Rogers* 18778 Z.

CAROLINA. Carolina *Galpin* 12494 K, s.n. BOL: *Moss & Rogers* 1146 K: *v. d. Merwe* 1093 K.PRE: *Rademacher* 7264 CGE: *Rogers* 19732 G.SAM.Z, 19780 S, 19876 SAM.

BARBERTON. Saddleback *Galpin* 529 BOL.K: Duivelskantoor *Thode* A.1601 K: Tweekloof *Thode* A.1159 PRE.

MIDDELBURG. Tantesberg *Mogg* 16945 PRE: Trichards Poort *C. A. Smith* 3465 PRE: *Verdoorn* PRE.

BELFAST. Belfast *Hutchinson* 2751 K: *Leendertz* 2763 K: *Worsdell* K: Dullstroom *Codd & de Winter* 3231 PRE.

HEIDELBURG. Heidelburg *Leendertz* 1034 BOL.K: *Wilms* 511 K, 512a, 512b Z.

POTCHEFSTROOM. Losberg *Theron* 759 PRE: Rietfontein *Schlechter* 3570 BM.BOL.G.K.S.Z.

JOHANNESBURG. Jo'burg *Barker* K: *Moss* 1612, 4364 BM, 6009 BM: *Pegler* 928 BOL: *Prosser* P1057 K.PRE: *Rand* 687, 984 BM: *Rogers* 149 BM, 1612 BM.K: *Silmore* G: Witwatersrand *Hutton* 894 GRA: West Rand *Gilliland* PRE: Observatory *Burtt-Davy* 18892 K: *Taylor* 1911 PRE: Klipriviersberg *Rendle* 149 BM: Donkerkloof *Repton* 576 PRE.

PRETORIA. Wonderboom Poort *C. A. Smith* 6119 PRE: *Wilms* 512b K: Hanops Riv. *Leendertz* 2421 K: *Prosser* 1364 K.KIR.PRE: *Steyn* 965 KIR: Pretoria *Story* 1457 PRE: Rietvlei *Mogg* 17236 PRE: *Repton* 3460 PRE: Irene *Hutchinson* 2396 BOL.K: *Rogers* 23837 Z: Pages Hotel *Rehmann* 6862 Z: Modderfontein *Conrath* 320 Z: Kaalfontein *Pole Evans* H13498 PRE: Ashbury *Repton* 676 PRE: *C. A. Smith* 1333 PRE.

KRUGERSDORP. Waterfall Fm. *J. Phillips* 366 PRE: Magaliesberg *Burke* 160 G.K.S, s.n. BM.K.TCD: *Zeyher* 616 BM.BOL.G.K.SAM, s.n. S: Florida *Esterhuysen* 3 BOL.

RUSTENBURG. Hammanskraal *Schlechter* 4183 Z.

WATERBERG. Zandrivierpoort *Rogers* 24974 Z: Geelhoutkop *Beyer* CGE.

LYDENBERG. Lydenburg *Wilms* 512 BM.G.K.Z: Steenkampsberg *Codd* 8223 K.PRE: *PoleEvans* 2029 K. 2030 K.PRE.

PILGRIMS REST. Mt. Anderson *Smuts & Gillett* 2377, 2438 PRE.

PIETERSBURG. Houtbosch *Pott* 4608 CGE: *Rehmann* 6364 BM.BOL.K.Z: Downs *Rogers* 22138 G.Z: Pietersburg *Junod* 2636 Z: Tabankula Mt. *Kotze* 539 PRE: Shilivwane *Junod* 830 G.K.

ZOUTPANSBERG. Zoutpansberg *Junod* 4262 Z.

? ? . "Boetsablon" *Schlechter* 4095 Z.

SWAZILAND. S.l. *Bolus* BOL.

Without locality:—*Burke* 543 Z: "East Transvaal" *Repton* 3509 PRE.

7. **Ps. mucronata** (Thunb.) Fenzl Ann. Wien. Mus. 2: 267. 1840.

Pharnaceum mucronatum Thunb. Hoffm. Phyt. Blaet. 1: 29. 1803; Fl. Cap. 2: 239. 1806.

Ps. androsacea Fenzl l.c. 265. 1840.

Short-stemmed with basal leaves, green or slightly glaucous, in loose or firm cushions or patches. Stems 2—10 cm. long, simple or more commonly branched, not widened at the tip. Leaf-tufts few or many, not depressed in the centre. Leaves 0·5—2 cm. long, 1—2·5 mm. wide, elongate-oblong or linear-spatulate, thin, rather translucent, distinctly narrowed to the base, acute or aristate with a short bristle, the midrib not projecting and often not visible. Leaves usually colourless at the base. Inflorescences few or many, erect or spreading, generally rather slender, 3—25 cm. high, simple or with ascending branches, the lower nodes 1—2 cm. apart. Bracts like the leaves but small, mucronate-bristled. Flowers in groups of 3—6, most often unilateral. Pedicels 1·5—2 mm. long, about as long as the bracts. Perianth segments 1—1·5 mm. long, incurved, with a broad membranous edge and a rounded bulging midrib. Stamens on or just outside a ring-like disc. Ovary 3 or 5-chambered: style as long as the ovary, 3 or 5-fid at the tip. Seeds brown, with fine concentric ridges.

The type is in herb. *Thunberg* U. (or *Ps. androsacea Drege* 3454 W).

Damp rocky places on mountains and in the grassveld in the eastern districts.

Distinguished from *Ps. myriantha*, with which it has been much confused in collections, by the more slender stems not widened at the top, the leaf-tufts not depressed on top, the thinner semitranslucent leaves distinctly narrowed to the base and with no prominent midrib, the slender inflorescences with less crowded often unilateral flowers, the mucronate bracts, and the short stigmas.

An exceedingly variable species in size, habit and general form, which much requires detailed experimental and field study. Variations in the

amount of branching of the stem, the number and size of the leaf-tufts, the length of the leaves, and in the number and extent of the inflorescences, seem largely related to habitat conditions and are connected by all intermediate stages. Though all are variable in the above features, three varieties are here recognised which have distinctive characters in the leaves and other features. Of these two were described by Fenzl under *Ps. androsacea.*

KEY TO THE VARIETIES.

1. Leaves with a thickened border and a long bristle at the tip: inflorescence with few or no nodes without flowers .. .. v. *marginata*
1. Leaves not thickened at the edges, often with a white membranous edge.
    2. Leaf-tufts compact: leaves translucent: inflorescence with few sterile nodes .. .. v. *mucronata*
    2. Leaf-tufts lax: leaves opaque: inflorescence with 2—8 nodes without flowers .. .. v. *foliosa*

Var. *mucronata.*

Ps. androsacea var. *enervis* Fenzl. Ann. Wien. Mus. 2: 261. 1840.

Variable in habit. Leaves in few or many compact crowded tufts. Leaves thin, semitranslucent, often white-edged in the upper half, acute, hair-pointed, the lower half usually colourless. Inflorescence simple or branched, with not more than 1—2 nodes without flowers. Flowers commonly unilateral.

CAPE.

SOMERSET EAST. Zuurberg *Schlechter* 6572 GRA: Boschberg *MacOwan* 1184 SAM, 1264 BM.K.Z.

GRAAF-REINET. Andriesberg *Galpin* 2029 K.

STOCKENSTROOM. Katberg *Esterhuysen* 13223 BOL.

KING WILLIAM'S TOWN. Pirie Forest *Sim* PRE: Mt. Kemp *Compton* 19188 KIR: *Leighton* 2748 BOL.

STUTTERHEIM. Ft. Cunningham *Sim* 2785 PRE.

CATHCART. Cathcart *Johnson* 1267 PRE: Dohne *Sim* 19542 PRE.

BEDFORD. Kagaberg *Bolus* 1161 BM.BOL.K.SAM.

FORT BEAUFORT. Katberg *Drege* CGE.S: *Dyer* 745 PRE: *Hutchinson* 1627 K.

BARKLY EAST. Doodmanskrantz *Galpin* 6634-5 BOL.K.

ALBERT. s.l. *Cooper* 650 BOL.TCD.Z, 712 K.

MT. CURRIE. Mt. Currie *Tyson* 1362 K.PRE.SAM.Zp.pte.

NATAL.

UNDERBERG. Underberg *McClean* 603 PRE.

DURBAN. Berea *Marais* 1313 PRE.

ESTCOURT. Estcourt 647 PRE.

WEENEN. Umhlumba Mt. *West* 1483 PRE.

BERGVILLE. Mt. aux Sources *Bayer & McClean* 190 PRE: *Killick* 1904 PRE: Drakensberg *Guthrie* 4817 KIR.

NEWCASTLE. Ingagone *Schlechter* 3413 Z.

ORANGE FREE STATE.

FOURIESBURG. Fouriesburg *Potts* 3095 PRE: Harrismith *Wood* 4716 BM, 4766 K, 5168 Z.

TRANSVAAL.

STANDERTON. Paardekop *Rehmann* 6834 K: Perekopberg *Rehmann* 6807 BOL.K.Z.

ERMELO. Ermelo *Leendertz* 3082 K: *Louw* 5 PRE: Nooitgedacht *Henrici* BOL.PRE.

CAROLINA. Carolina *Rademacher* 7275 CGE.

HEIDELBURG. Benoni *Bradfield* T201 K.

JOHANNESBURG. Robinson *Moss* 16649 BM.

PRETORIA. Rietfontein *Moss* 11426 PRE.

KRUGERSDORP. Waterfall Fm. *J. Phillips* 366 PRE.

RUSTENBURG. Magaliesberg *Mogg* 15137 PRE: *C. A. Smith* 1749 Z.

POTCHEFSTROOM. Ventersdorp *Sutton* 501 PRE.

NYLSTROOM. Nylstroom *v. Dam* K: Platberg *Putterill* PRE.

PIETERSBURG. Houtbosch *Rehmann* 6363 K.Z.

BASUTOLAND. Leribe *Dieterlen* 295 K.PRE.SAM.Z, 6874 BM: *E. P. Phillips* 687, 795 SAM: Mamalepi *Compton* 21286, 21356 KIR: *Guillarmod* 639, 1221 PRE: Thaba Bosin *Junod* 1783, 1908a Z: Balati Mts. *Staples* 165 PRE: s.l. *Cooper* 930 K.Z, s.n. BOL: *Guillarmod* 191, 395 PRE.

Without locality:—*Drege* s.n. S, do (*Ginginsia glaucescens*) BM.G.K. OXF.S.TCD: *Ecklon & Zeyher* s.n. TCD: *Wahlberg* S.

PORTUGUESE EAST AFRICA. Sofala *Exell, Mendonca & Wild* 255 BM.

Var. *marginata* Adamson comb. nov.

Ps. androsacea var. *marginata* Fenzl Ann. Wien. Mus. 2: 265. 1840.

Leaf-tufts usually small. Leaves 0·5—1·3 cm. long, erect, firm, opaque, the margins distinctly thickened at least in the upper half, the tip with a rigid bristle, the midrib distinct and slightly projecting in the dry state. Otherwise like var. *mucronata*.

The type, *Drege* 3454 B, is lost, neotype *Drege* (*Ps. androsacea* var. *marginata*) S.

STERKSTROOM. Penhoek Pass *Acocks* 18678 PRE.

MOLTENO. Zuurpoort *Ecklon & Zeyher* 112.11 S.Z: Blesbokvlakte *Drege* G.S.SAM.

"Griqualand East" *Anderson* BOL: "Cisgaripina" *Zeyher* K.

BETHLEHEM. Witzieshoek *Flanagan* 1872 PRE.SAM: Clarens *Connell* 66 PRE.

CAROLINA. Carolina *Acocks* 13938 PRE.

BARBERTON. Kaapsche Hoop *Wager* BM.

HEIDELBURG. Benoni *Louw* 977 PRE.

LIONS RIV. Howick *Hutton* 163 BM.

BASUTOLAND. Leribe *Dieterlen* 295 K.p.pte: Thcba Tsuma *Page* PRE: s.l. *Cooper* 712 BM.BOL.K.

Var. *foliosa* Adamson var. nov.

A typo differt foliis erectis paulo congestis nervis obscuris in sicco involutis, inflorescentiis longis nodis basalibus pluribus 4—10 folia solum ferentibus.

In lax patches not in cushions. Basal stems slender, woody, with horizontal branches. Leaf-tufts not dense, usually separated. Leaves erect, 2—3 cm. long, dark green, opaque, uniformly coloured, involute when dry, the midrib not visible. Inflorescences tall, erect or spreading, with 4—10 nodes at the base with leaves but no flowers.

The type is *C. A. Smith* 1747 PRE.

A much laxer plant than var. *mucronata* with quite different leaves which are green to the base.

LUSIKISIKI. Lusikisiki *Leighton* 3126 BOL.

PORT SHEPSTONE. Pt. Shepstone *Hafstrom & Acock* 420 PRE.S: Pt. Edward *Acocks* 13349 PRE.

BERGVILLE. Cathedral Pk. *Killick* 1167 K.PRE, 1239 BOL. K.PRE.

PRETORIA. Wonderboom Poort *Pole Evans* 215 PRE: *Rehmann* 4561 BM.K.

RUSTENBURG. Magaliesberg *Esterhuysen* 2 BOL: *C. A. Smith* 1747 PRE.

WATERBERG. Groothoek *Codd* 3961 PRE: Hangklip *Maguire* 1436 KIR.

8. **Ps. obovata** Adamson sp. nov.

Caules plures herbacei prostrati foliosi pauciramosi. Folia numerosa alterna in caule inserta et ad apicem congesta sed non comosa, albo-marginata apice obtusa vel mucronata basi cuneata subpetiolata. Inflorescentia tenuis simplex nodis floriferis 2—4. Bracteae foliosae stipulis acuminatis. Pedicelli florum bracteis breviores perigonio duplo longiores.

Green or glaucous, in loose patches. Stems many, prostrate, herbace-

ous, 10—20 cm. long. Leaves alternate, all along the stem, crowded in the upper part with some in a terminal tuft. Leaves 3—6 mm. long, 1—1·5 mm. wide, obovate, obtuse but abruptly mucronate or apiculate, much narrowed to the base and almost petiolate, the margins pale-coloured. Inflorescence very slender, sprawling, unbranched, 2—6 cm. long, with 2—5 nodes each with few, 2—3, flowers. Bracts like leaves but narrower and more acute: stipules half as long as the bracts, narrow, acuminate. Pedicels 2 mm. long. Perianth 1 mm. long, the segments obtuse, incurved, green with a broad membranous margin, the midrib obtusely bulging. Stamens short, attached outside a cup-like disc. Ovary depressed: style short, 3-fid at the tip.

The type is *Killick & Marais* 2198 K.

Damp sheltered rocks on the higher Drakensberg.

Distinctive in habit and in leaf. Allied to *Ps. alternifolia* but much larger and with quite different leaves.

NATAL. Mt. aux Sources *McClean & Bayer* 276 K: *Steyn* 1029 KIR: *Prescott-Decie* BOL: Sentinel Pk. *Killick & Marais* 2198 K: Natal Nat. Park *Hutchinson* 4571 K.

BASUTOLAND. Mts. near Leribe *Dieterlen* s.n. BM.

9. **Ps. alternifolia** Killick Bothalia 6: 445. 1954.

Small, in low cushions or patches. Stems procumbent, 2—20 cm. long, much branched. Leaves crowded at the branch tips and some along the stem. Leaves 2—3·5 mm. long, about 1 mm. wide, elliptical-oblong, not or very slightly narrowed to the base, shortly mucronate at the tip, usually with a white membranous margin in the upper half. Inflorescence erect, 0·5—2 cm. high, unbranched, with 1—3 nodes with rather crowded flowers. Bracts flat, longer than the pedicels. Pedicels as long as or shorter than the perianth. Perianth 1—2 mm. long, the lobes obtuse, cucullate. Stamens inserted outside a cup-like disc. Stigmas short, 3, on a short style.

The type is *Killick* 1482 K.

Sheltered rock crevices on the higher summits of the Drakensberg. Much smaller than *Ps. mucronata* or *Ps. obovata*, with very small leaves which are not narrowed to the base. The older leaves are often yellow-brown. The inflorescences may be formed in large numbers.

NATAL. Mt. aux Sources *Edwards* 615 PRE: *Hutchinson* 4586 K: *Marloth* 2685 BOL, 2865b PRE, 5404 PRE, 5493 SAM: *Potts* 2971 PRE: Sentinel Pk. *Killick & Marais* 2190 PRE: Organ Pipes Pass *Killick* 1842 K.PRE: Castle Buttress *Killick* 1482 K.PRE: Cliff Pk. *Schelpe* 475 PRE: Cathedral Pk. *Esterhuysen* 10225 BOL: Ndedena *Esterhuysen* 17340 BOL: Muweni *Esterhuysen* 21654 BOL.

BASUTOLAND. Meroneng *Liebenberg* 5850 PRE: Makhotlong *Guillarmod* 1177 PRE.

10. **Ps. frigida** Schltr. J. Bot. 34: 500. 1896.

A very small herbaceous plant in tufts or patches 3—10 cm. across, often purplish in colour. Leaves much crowded at the branch tips with a few scattered. Leaves incurved, 2—3 mm. long, oblong or obovate, obtuse mucronate subacute or apiculate, slightly narrowed to the base, with a distinct thickened pale-coloured border in the upper half. Inflorescence 0·5—1 cm. high, usually unbranched, with 1—5 nodes. Bracts like leaves but narrower, concave above, mucronate, shorter than the flowers. Pedicels 1—1·5 mm. long. Perianth 1·5 mm. long, the segments obtuse, incurved, more or less cucullate, bulged on the back. Disc minute. Ovary 4 or 5-chambered: style 4 or 5-fid at the top: stigmas small, knob-like. Fruit as long as the perianth. Seeds brown, finely punctate.

The type is *Marloth* 2230 B (lost) cotype PRE.

Rock crevices on mountain summits in the western Cape.

A species geographically isolated from its immediate allies. Distinguished by the small size, the incurved bordered leaves, the minute disc, and the style and stigmas.

CLANWILLIAM. Cedarberg *Primos* PRE: Tafelberg *Barnard* 758 SAM: *Esterhuysen* 21409 BOL.

SUTHERLAND. Roggeveld *Marloth* 9707a PRE.

TULBAGH. Gt. Winterhoek *Esterhuysen* 27055 BOL.

WORCESTER. Matroosberg *Esterhuysen* 27669, 27677 BOL: *Marloth* 2230 BOL.PRE: *E. P. Phillips* 2032 SAM: *Stokoe* 8712 BOL: Roodeberg *Esterhuysen* 20914 BOL.

PRINCE ALBERT. Seven Weekspoortberg *Barnard* SAM: *Primos* 67 PRE.

11. **Ps. obtusa** Adamson sp. nov.

Herbacea pusilla prostrata. Folia alterna obovato-spatulata obtusa albomarginata. Flores ex como terminale axillares pedunculo nullo pedicellis foliis duplo vel triplo longioribus. Perigonii segmenta obtusa incurva. Stamina in disco perparvo inserta. Ovarium triloculare. Semina minute punctulata.

A very small prostrate herb in patches 3—5 cm. across. Leaves alternate, crowded at the branch tips but not in dense tufts, obovate-spatulate, 1—2 mm. long, obtuse, slightly narrowed to the base, rather thick, concave above, with a narrow white border. Flowers in groups of 3 or more in the axils of the crowded terminal leaves, with no common

peduncle. Pedicels 2—5 mm. long. Perianth 1—1·5 mm. long, the segments incurved, obtuse, smooth on the back. Stamens on a minute disc. Ovary 3-chambered: style short. Seeds dark brown, finely punctulate, without ridges.

The type is *Guillarmod* 2045 PRE.

Damp rocks on the higher peaks of the Drakensberg.

NATAL. Cathkin Pk. *Esterhuysen* 8803 BOL.

BASUTOLAND. Thi'Ktlampana *Guillarmod* 2340 PRE: Tseou Riv. *Guillarmod* 2045 PRE: Mt. aux Sources *Flanagan* 2131 BOL.PRE.

INDEX.

INDEX OF NUMBERED SPECIMENS QUOTED.

DIETERLEN. 295 *mucronata* & v. *marginata; 6874 mucronata.*
DREGE. 3454 *mucronata.*
DYER. 745 *mucronata.*
ECKLON. 468 *marginata.*
ECKLON & ZEYHER. 112.11 *mucronata* v. *marginata;* 137.10, 1832 *quadrangularis;* 1833 *marginata;* 2501 *marginata.*
EDWARDS. 615 *alternifolia.*
ETERHUYSEN. 2 *mucronata* v. *foliosa;* 3 *myriantha;* 3651 *quadrangularis;* 8803 *obtusa;* 10224 *myriantha;* 10225 *alternifolia;* 12277 *anguina* & *quadrangularis;* 12682, 13038 *quadrangularis;* 13223 *mucronata;* 13459, 16159a, 17059 *quadrangularis;* 17340 *alternifolia;* 18036 *diffusa;* 20478, 20643, 20913 *quadrangularis;* 20914 *frigida;* 20919, 21409 *frigida;* 21654 *alternifolia;* 21884 *anguina* & *quadrangularis;* 22000 *spicata;* 24077 *quadrangularis;* 27055, 27669, 27677 *frigida.*
EXELL, MENDONCA & WILD. 255 *mucronata.*
FAIRALL. 145 *myriantha.*
FLANAGAN. 145 *myriantha;* 1872 *mucronata* v. *marginata;* 2131 *obtusa;* 2776 *myriantha.*
FISHER. 917 *myriantha.*
FORBES. 611 *myriantha.*
GALPIN. 529 *myriantha;* 2029 *mucronata;* 6634-5 *mucronata;* 9577, 12494 *myriantha.*
GERRARD. 1521 *myriantha.*
GERRARD & McKEN. 821, 1521 *myriantha.*
GERSTNER. 4667 *myriantha.*
GUILLARMOD. 191, 395, 639, 850 *mucronata;* 1177 *alternifolia;* 1221 *mucronata;* 2045, 2340 *obtusa.*
GUTHRIE. 4817 *mucronata.*
HAFSTROM & ACOCK. 420 *mucronata* v. *foliosa;* 436 *quadrangularis.*
HENRICI. 1306 *mucronata;* 1684 *myriantha.*
HUTCHINSON. 577 *anguina;* 1627 *mucronata;* 2396, 2751 *myriantha;* 4571 *obovata;* 4586 *alternifolia.*
HUTTON. 163 *mucronata* v. *marginata;* 894 *myriantha.*
JACOTTET. 407 *myriantha.*
JUNOD. 830 *myriantha;* 1783, 1908a *mucronata;* 2636, 4262 *myriantha.*
KILLICK. 1167, 1239 *mucronata* v. *foliosa;* 1482, 1824 *alternifolia;* 1904 *mucronata.*
KILLICK & MARAIS. 2160 *myriantha;* 2190 *alternifolia;* 2198 *obovata.*
KOTZE. 539 *myriantha.*
KRAUSS. N4 *myriantha.*
LEENDERTZ. 1034, 2421, 2763 *myriantha;* 3082 *mucronata.*
LEIGHTON. 2748 *mucronata;* 3126 *mucronata* v. *foliosa.*
LEIPOLDT. 4008 *quadrangularis.*
LIEBENBERG. 5850 *alternifolia.*
LOUW. 5 *mucronata;* 977 *mucronata* v. *marginata.*
MCLEAN. 603 *mucronata.*
MCLEAN & BAYER. 276 *obovata.*
MACOWAN. 1184, 1284, 1484 *mucronata;* 3265 *quadrangularis.*
MAGUIRE. 1436 *mucronata* v. *foliosa.*
MARAIS. 875 *myriantha;* 1313 *mucronata.*
MARLOTH. 1990 *quadrangularis;* 2230 *frigida;* 2685, 2865b *alternifolia;* 3281 *quadrangularis;* 5404, 5493 *alternifolia;* 9707a *frigida.*
V. D. MERWE. 1093 *myriantha.*
MOGG. 5546 *myriantha;* 15137 *mucronata;* 16945, 17236 *myriantha.*
MOSS. 1612, 4364, 6009 *myriantha;* 11426, 16649 *mucronata.*
MOSS & ROGERS. 1146 *myriantha.*
NIVEN. 27 *quadrangularis.*
PEGLER. 928 *myriantha.*
PHILLIPS, E. P. 687, 795 *mucronata;* 2032 *frigida;* 2034 *quadrangularis.*
PHILLIPS, J. 366 *mucronata* & *myriantha.*
POLE EVANS. 215 *mucronata* v. *foliosa;* 2029, 2030 *myriantha;* H13498 *myriantha.*
POTT. 4608 *myriantha.*
POTTS. 2971 *alternifolia;* 3095 *mucronata.*
PRIMOS. 67 *frigida.*

PROSSER. P1057, 1364 *myriantha.*
RADEMACHER. 7264 *myriantha;* 7275 *mucronata.*
RAND. 687, 984 *myriantha.*
REHMANN. 502 *myriantha;* 4561 *mucronata* v. *foliosa;* 6363 *mucronata;* 6364 *myriantha;* 6807, 6834 *mucronata;* 6862, 7546, 8396 *myriantha.*
RENDLE. 149 *myriantha.*
REPTON. 576, 676, 3460, 3509 *myriantha.*
ROGERS. 149, 1612, 18778, 19732, 19780, 19876, 22138, 24724, 24974, 28295 *myriantha.*
RUDATIS. 457, 1474 *myriantha.*
SANKEY. 18 *myriantha.*
SCHELPE. 475 *alternifolia.*
SCHLECHTER. 657a *myriantha;* 939 *anguina;* 3402 *myriantha;* 3413 *mucronata;* 3431, 3570, 4095, 4183 *myriantha;* 6572 *mucronata;* 10166 *anguina* & *quadrangularis.*
SIM. 2785, 19542 *mucronata.*
SMITH, C. A. 1333, 1346 *myriantha;* 1747 *mucronata* v. *foliosa;* 1749 *mucronata;* 3465, 6119 *myriantha.*
SMUTS & GILLETT. 2377, 2438 *myriantha.*
STAPLES. 165 *mucronata.*
STEYN. 827, 965 *myriantha;* 1029 *obovata.*
STOHR. 45 *myriantha.*
STOKOE. 7318 *quadrangularis;* 8712 *frigida.*
STORY. 1457 *myriantha;* 4355 *quadrangularis.*
SUTTON. 501 *mucronata.*
TAYLOR. 1911 *myriantha.*
THERON. 759 *myriantha.*
THODE. A1159, A1601 *mucronata.*
TYSON. 1362 *mucronata* & *myriantha;* 1363 *myriantha.*
WAGENER. 234 *quadrangularis.*
WEST. 647, 1483 *mucronata.*
WILMS. 511, 512, 512a, 512b, 572 *myriantha.*
WOOD. 1, 602 *myriantha;* 4716, 4766, 5186 *mucronata;* 5728, 9715, 10102 *myriantha.*
ZEYHER. 50 *quadrangularis;* 468 *marginata;* 616 *myriantha;* 1829 *quadrangularis;* 2501 *marginata.*

A REVISION OF EPISCHOENUS C.B.Cl.

By

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INTRODUCTION.

In 1895 C. B. Clarke founded the monotypic genus Epischoenus for a species, *E. quadrangularis*, which had been first assigned to Schoenus by O. Boeckeler in 1874. The significant differences between the spikelet of this new genus and that of Schoenus were two in number: (*a*) in Epischoenus a single bisexual floret occurred above two functionally male, whereas in Schoenus two or three bisexual florets were found below the male, and (*b*) in Epischoenus a thickened prolongation of the axis developed above the bisexual floret, ultimately curving round the fruit, whereas in Schoenus a similarly thickened and elongated part of the axis occurred between the bisexual florets. As was pointed out in a previous publication (Levyns 1947), Clarke appears not to have seen the fruit of *Epischoenus quadrangularis* and described the nut of another species, *Epischoenus adnatus*, easily confused with it and also occurring on Table Mountain. In essential features the definition of Epischoenus remains as given by Clarke. Naturally a few emendations are necessary owing to the increased knowledge of the genus. These have been incorporated in the description given later.

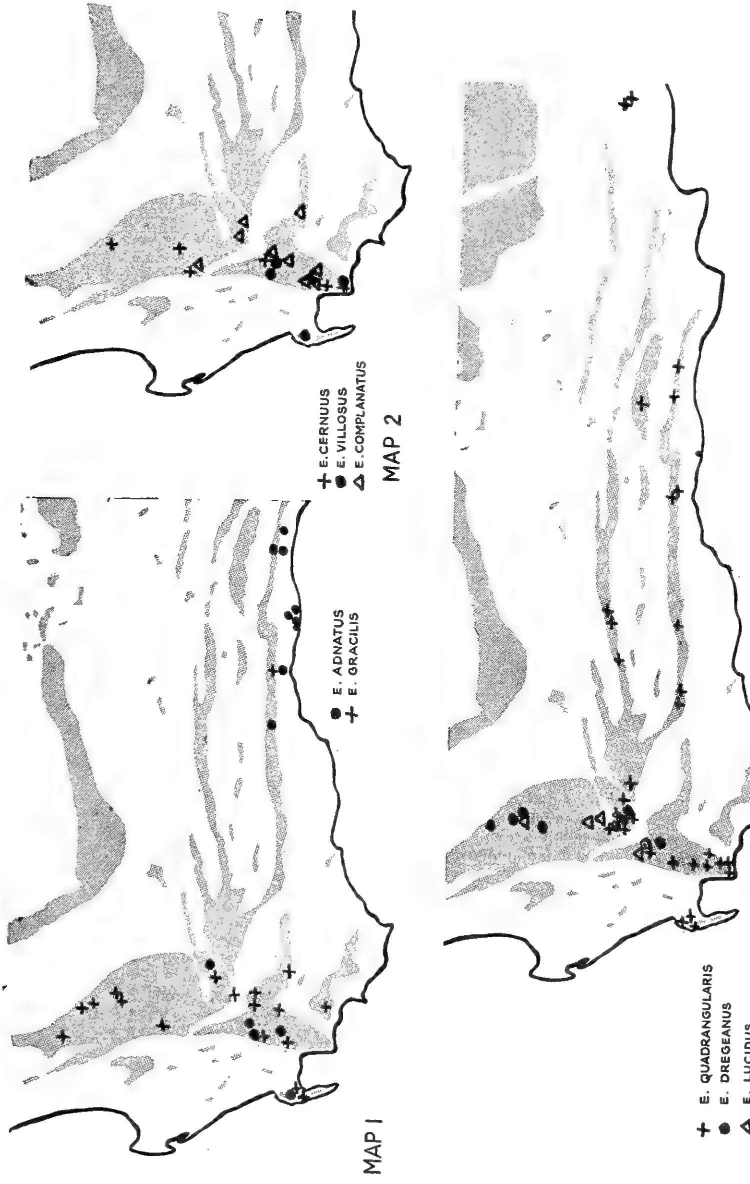
In 1941 a second species, *E. gracilis*, was described and in 1947 three more were added, *E. adnatus*, *E. villosus* and *E. eriophorus*, the last of which species is now known to have been described by C. B. Clarke in 1900 as *Tetraria lucida*. In the present revision of the genus two new species are added and two new combinations made. *Tetraria gracilis* Turrill also belongs to this genus. The epithet *gracilis* has been used in Epischoenus for a different species and therefore is not available. *T. gracilis* Turrill is, however, synonymous with Epischoenus *adnatus* Levyns and a new name is unnecessary. The total number of species is therefore eight but it is likely that new species await discovery. Cyperaceae is rarely a popular family with collectors and it is significant that of the 105 specimens of Epischoenus in the Bolus Herbarium, 86 were collected by one person, Miss E. Esterhuysen. She, by her enthusiastic exploration of the high mountains of southern Africa, has added greatly to our knowledge of the flora.

One of the problems facing the monographer of this genus, is that until in fruit there is little guide from external appearance as to the age of the spikelet. A spikelet which looks mature may contain rudimentary florets and the identification of the species in such cases is difficult, sometimes impossible, for the most helpful characters in making a diagnosis are those of the bisexual floret and the fruit. Many of the South African Cyperaceae become more conspicuous at the time of flowering when the stamens and style branches protrude. This is true of Epischoenus. It is remarkable that few herbarium specimens have been collected at this stage of development. An observation made by the author on two species, *E. lucidus* and *E. dregeanus*, may account for this. The florets of these species open just before sunrise and for a few hours their large yellow stamens and glistening white style branches make them conspicuous. Long before midday these organs have started to wither and the plant assumes its normal rather drab appearance. As few botanists start their activities at dawn, this phenomenon, if it be general in the genus, may account in part for its neglect by the average collector.

HABITAT AND DISTRIBUTION.

All the species of Epischoenus are moisture-loving plants, and in this respect contrast strikingly with the closely allied but much larger genus Tetraria where the majority of the species grow in dry places. Given a suitable habitat, Epischoenus may occur from a little above sea-level to an altitude in the neighbourhood of 1,850 metres. An examination of the existing records makes it clear that Epischoenus has a marked preference for high altitudes. Every one of its species is capable of reaching an altitude of at least 1,500 metres.

In spite of the imperfections of the record in this somewhat neglected genus, it is clear from the pattern of distribution that it belongs to the Cape Flora (Maps 1—3). The greatest concentration of species is to be found in the combined divisions of Tulbagh and Worcester, where all eight species occur. The neighbouring divisions of Paarl and Stellenbosch come next with seven species. It is probably more than a coincidence that in this region where the two principal mountain systems of the southern Cape Province meet, there should be a high concentration of species in those taxa which are predominantly montane in distribution. If the Cape Flora be considered as a whole, then the area of concentration of its species is in the more southerly Caledon Division, but in the taxa, where a large proportion of the species grow at high altitudes, the area of concentration tends to shift further to the north. This phenomenon is clearly brought out in the large genus Muraltia, where there are two



MAPS 1—3.
In all the maps the stippled areas represent mountains.

subgenera. One, Psilocladus, is predominantly montane, the other, Muraltia, has the majority of its species in the lowlands. The difference in the region of concentration of species is striking, for in the subgenus Psiloclada the highest number of species occurs in the Worcester-Tulbagh area, while in the subgenus Muraltia it is in the Caledon Division. When more is known about the flora of the higher mountains in southern Africa this phenomenon may be found to be of general occurrence.

EPISCHOENUS.

C.B.Cl. Dur. & Schinz Conspect. Fl. Afr. V, p. 657 (1895).

Tufted perennials, often with the leaves reduced to sheaths, usually mahogany red at the base. Spikelets compressed, the bracts more or less 2-ranked, cymose (Fig. 1 E). Empty bracts at the base of the spikelet

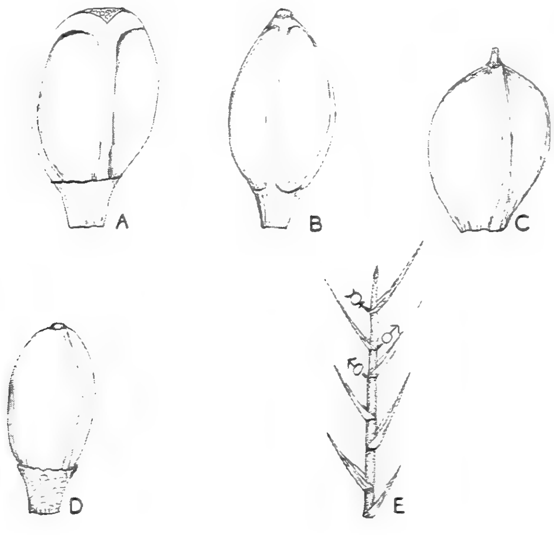


FIG. 1.—A. Fruit of *E. quadrangularis*. × 10.
B. Fruit of *E. villosus*. × 10.
C. Fruit of *E. adnatus*. × 10.
D. Fruit of *E. gracilis*. × 10.
E. Diagram of the spikelet in Epischoenus. In a few species the prolongation of the axis beyond the bisexual floret is adnate to the bract.

3—12, followed by 1—4 bracts with functionally male florets with or without an abortive gynoecium, finally one bisexual floret. Axis of the spikelet produced beyond the bisexual floret, bearing one or more sterile

bracts at its tip, rarely the lowest of these with a male floret: the prolongation of the axis free from or adnate to the bract at its base, usually becoming curved and cartilaginous as the fruit develops. Hypogynous bristles rudimentary or lacking. Stamens 3, the anthers linear with a sterile linear-lanceolate tip. Style branches 3. Fruit stipitate or sessile, sometimes with a cup-like disc at its base.

Key to the Species.

A. Lamina of the leaves, when present, and flowering stems much compressed: spikelets glabrous . . . . 7. *complanatus*

A. Lamina of the leaves often lacking, if present then not laterally compressed: flowering stems terete or angled, rarely compressed, but if so then the bracts of the spikelet with an apical tuft of woolly hairs.

  B. Bracts of the spikelet with long weak hairs either at the apex or along the margin.

    C. Supra-floral axis free from its basal bract: spikelet about 9 mm. long . . . . 2. *villosus*

    C. Supra-floral axis shortly adnate to its basal bract: spikelet about 15 mm. long . . . . . . 6. *lucidus*

  B. Bracts of the spikelet glabrous.

    D. Supra-floral axis free from its basal bract.

      E. Curly grass-like leaves present: fruit covered with prominent tubercles or ridges . . . . 8. *cernuus*

      E. Leaves usually without a lamina but if present then neither grass-like nor curly.

        F. Ovary and fruit seated on a conspicuous cup-like disc: fruit somewhat narrowed towards the apex and crowned with the small hardened style base . . . . 3. *gracilis*

        F. Ovary and fruit stipitate, without a cup-like disc, not narrowing towards the apex: the fruit terminated by a broad, flat, non-shining top . . . . . . 1. *quadrangularis*

    D. Supra-floral axis adnate to its basal bract.

      G. Stems rather rigid: fruit minutely tuberculate in the upper part, rough near the base . . 4. *dregeanas*

      G. Stems not rigid: fruit smooth and shining throughout . . . . 5. *adnatus*

1. **E. quadrangularis** C.B.Cl. Dur. & Schinz Conspect. Fl. Afr. V, p. 657 (1895), Fl. Cap. VII, p. 273 (1898). Levyns in Adamson & Salter, Fl. Cap. Penin., p. 121 (1950). *Schoenus quadrangularis* Boeck. in Linnaea 38, p. 274 (1874).

A perennial, 30—75 cm. high. Leaf sheaths clasping the bases of the flowering stems: lamina usually lacking. Flowering stems often grooved and 4-angled below the inflorescence, occasionally more or less terete, bearing near the apex two stiff, dull brown bracts partly concealing the spikelets. Spikelets few to several, about 10 mm. long, linear, compressed, dark brown, sterile bracts 4—8, somewhat acute; male florets 1—4; supra-floral axis free from the bract. Ovary with a large opaque cap. Fruit stipitate, 3-angled, with conspicuous ribs running down the edges,

pale brown, shining, with a characteristic dark, triangular, non-shining somewhat flattened area at the apex. (Fig. 1 A.)

ISOTYPE. Burchell 557 (Kew).

HABITAT. Damp places at altitudes from a little above sea-level to 1,670 metres.

NOTE. Esterhuysen 17013, collected on the Langeberg near Riversdale, has abortive fruits with peculiar longitudinal ribs between the main ribs. The young ovary is typical of this species and without fully formed fruits it would be rash to create a new species. There are four male florets in the majority of the spikelets, a larger number than is usually present in *E. quadrangularis.*

CERES. Schurfteberg Peak: Esterhuysen 14716. Michells Pass: Stokoe. Witels Kloof: Esterhuysen 21854, 26329.

WORCESTER. Fonteintjiesberg: Esterhuysen 10975. Keeromsberg: Esterhuysen 10156. Waaihoek Mountain: Esterhuysen 8295, 22672.

PAARL. Wemmershoek Mountains: Esterhuysen 9064.

STELLENBOSCH. Victoria Peak: Esterhuysen 17578. Guardian Peak: Esterhuysen 11995.

CAPE. Orange Kloof: Levyns 6370. Table Mountain: Levyns 7027, 7596; Esterhuysen 379, 720, 4899, 16810, 17421, 26572, 26660, 26665, 26666. Kirstenbosch: Esterhuysen 12534. Devils Peak: Esterhuysen 10043.

CALEDON. Wilde Paardeberg: Stokoe 2795. Greyton, Rivier Zonder Einde Mountains: Esterhuysen 20794. Betty's Bay: Parker 4515. Palmiet River Mouth: Esterhuysen 12550; Levyns 8157, 9376. Klein River Mountains: Esterhuysen 2916. Houw Hoek: Schlechter 7402.

SWELLENDAM. Langeberg near Strawberry Hill: Esterhuysen 10402, 10497. Swellendam Mountain: Esterhuysen 4797.

RIVERSDALE. Langeberg: Esterhuysen 17013.

LAINGSBURG. Anysberg: Esterhuysen 17084.

LADISMITH. Klein Swartberg: Levyns 9112. Seven Weeks Poort: Esterhuysen 24805.

GEORGE. Montagu Pass: Fourcade 6472; Esterhuysen 10864; Levyns 10502. George: Levyns 10575.

UNIONDALE. Near Joubertina: Esterhuysen 6861, 16394, 27308. Kouga Mountains: Esterhuysen 10781.

HUMANSDORP. Witte Els Bosch: Esterhuysen 6771.

ALBANY. Grahamstown: Rhodes University, 2910, 3101.

2. **E. villosus** Levyns Jour. S. Af. Bot. XIII, p. 56, Fig. 2 E—G (1947).

A tufted perennial up to 90 cm. high. Leaves reduced to sheaths, often villous when young. Flowering stems terete, slender or somewhat

stout, bearing towards the apex 2 or 3 erect, villoso-ciliate bracts exceeding in length the few closely arranged spikelets. Spikelets about 9 mm. long, narrowly lanceolate, somewhat compressed, with 6—8 bracts, the lower sterile, acute or acuminate, the upper 1—4 floriferous, the male florets usually without gynoecia; the bracts villous towards the apex, the lower fringed with long matted hairs. Supra-floral axis free from the bract, occasionally with an abortive male floret within its terminal bract. Fruit narrowly ellipsoidal, pale, trigonous, shortly stipitate, with a small rather obtuse beak. (Fig. 1 B.)

TYPE. Levyns 8150 (Bolus Herbarium).

HABITAT. Damp places at altitudes from 180 to 1,830 metres.

WORCESTER. Slanghoek mountains: Esterhuysen 18528.

PAARL. Bains Kloof: Esterhuysen 26300.

CAPE. Nursery Gorge, Table Mountain: Esterhuysen 11724. Table Mountain: Esterhuysen 16927.

CALEDON. Palmiet River Mouth: Levyns 8150.

3. **E. gracilis** Levyns Jour. S. Af. Bot. VII, p. 81. Fig. 3 (1941).

A densely tufted perennial up to 90 cm. high. Leaf sheaths with a much reduced lamina or none. Flowering stems slender, wiry, faintly grooved. Lowest bract overtopping the lax inflorescence; spikelets few to several on pedicels of varying length, some very short, others usually long, capillary. Spikelets about 10 mm. long, narrow, the bracts firm in texture; 4—8 sterile bracts at the base, then 1 or 2 with functionally male florets. Supra-floral axis free from the bract. Fruit pale, shining, oblong or ellipsoidal, trigonous, often crowned by the thickened base of the style, seated on a rugose or almost smooth cup-like disc. (Fig. 1 D.)

TYPE. Levyns 7389 (Bolus Herbarium).

HABITAT. Marshy places at altitudes from 300 to 1,670 metres.

CLANWILLIAM. Cedarberg: Esterhuysen 13121; Stokoe 9286. Boontjieskloof, Cedarberg: Esterhuysen 12215. Between Pakhuis and Heuningvlei: Esterhuysen 7457.

CERES. Elands Kloof: Levyns 8096, 8100, 8122, 9241, 9339.

WORCESTER. Slanghoek Mountain: Esterhuysen 16512, 16525. Fonteintjiesberg: Esterhuysen 16694. Du Toits Peak: Esterhuysen 16650. Du Toits Kloof: Esterhuysen 19883. Chavonnesberg: Esterhuysen 14590.

TULBAGH. Twenty-Four Rivers Mountains: Esterhuysen 16204.

PAARL. Suurvlakte: Esterhuysen 11534, 12337. Wellington Sneeuwkop: Esterhuysen 12443.

STELLENBOSCH. Jonkershoek: Levyns 7389. Mountains near Stellenbosch: Esterhuysen 12498.

CAPE. Between Bakoven and Llandudno: Esterhuysen 15397. Kirstenbosch: Esterhuysen 11812, 14389.

CALEDON. Gem Kloof, French Hoek Mountains: Esterhuysen 11416. Genadendal: Stokoe s.n. Shaws Mountain: Levyns 9496.

RIVERSDALE. Langeberg: Esterhuysen 17252.

GEORGE. George: Levyns 10575.

4. **E. dregeanus** (Boeck.) Levyns comb. nov.

Elynanthus dregeanus Boeck. in Linnaea 38, p. 262 (1874). *Tetraria dregeana* C.B.Cl. in Dur. & Schinz Conspect. Fl. Afr. V, p. 661 (1895); Fl. Cap. VII, p. 278 (1898).

When Boeckeler founded *Elynanthus dregeanus* he quoted as his type a specimen collected by Drege but without giving a number or locality. When Clarke transferred it to Tetraria in 1895 he cited two specimens, Burchell 7137 and Drege, again without number or locality. Three years later in the Flora Capensis, Clarke gave the additional information that the Drege specimen was Drege 1632a and came from Du Toits Kloof. The present author has seen neither of the specimens quoted in the Flora Capensis but Schlechter 9964 from Michells Pass, in the Bolus Herbarium, was named *Tetraria dregeana* by C. B. Clarke in 1904. This was confirmed by W. B. Turrill in 1924. Abundant material of a species which agrees with Schlechter 9964, has been collected in recent times in places ranging from the Clanwilliam Division in the north to the Paarl Division in the south. Both Drege 1632a and Schlechter 9964 were collected within the area and therefore it is probable that the epithet dregeanus may be applied safely to the specimens quoted below. Neither Boeckeler nor Clarke saw the fruit of this species and the spikelets in the material they examined were obviously young. Thus they missed the characteristic prolongation of the axis which characterises the genus Epischoenus. The description which follows has been made from the many specimens now available. The drawings depicted in Fig. 2 A and B were made from fresh material of Levyns 9379. Fig. 2 C was made from Levyns 9226.

Epischoenus dregeanus is a western species and it is unlikely that Burchell 7137 from the Langeberg near Riversdale is this.

A glabrous perennial, 20—70 cm. high. Leaf sheath firm, the lamina reduced, up to 10 cm. long, dry and brown when the plants are in flower. Flowering stems terete, erect, slender, rigid, the inflorescence overtopped by the stiff, leafy basal bract. Inflorescence, excluding the bracts, 2—3 cm. long. Spikelets 10—12 mm. long, pale brown, compressed, narrow, 5—8 in a compact inflorescence. Sterile bracts 4 or 5, the lowest acuminate,

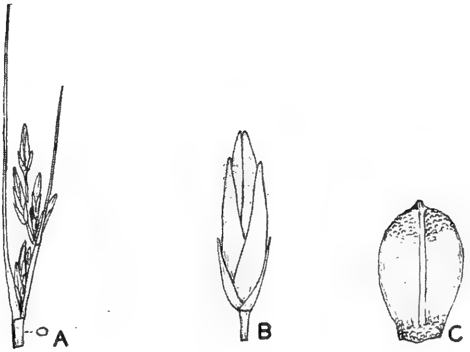


FIG. 2.—*Epischoenus dregeanus.*
A. Inflorescence. Natural size.
B. Spikelet. × $2\frac{1}{2}$.
C. Fruit. × 10.

scarious at the tip, the upper somewhat acute. Fertile bracts usually 3, rarely 4. Supra-floral axis adnate to the bract, becoming free a short distance below its own reduced bract. Three small bristles sometimes present outside the stamens in the bisexual floret. Ovary with an obtuse scabrous beak. Fruit obovoid or oblong, obtusely trigonous, olive brown, often with a small button-like apex, minutely tuberculate in the upper part, more or less smooth in the middle and rough near the base.

LECTOTYPE. Drege 1632a.

HABITAT. Marshy places at altitudes from 600 to 1,500 metres.

CLANWILLIAM. Cedarberg Tafelberg: Esterhuysen 13798.

CERES. Elands Kloof: Levyns 8111, 9226, 9322, 9324, 9326, 9329, 9338, 9367, 9379, 9838. Cold Bokkeveld: Esterhuysen 12668. Michells Pass: Schlechter 9964. Michells Peak: Esterhuysen 15146, 15213.

WORCESTER. Waaihoek Mountain: Esterhuysen 8341.

PAARL. Bains Kloof: Esterhuysen 25608. Suurvlakte: Esterhuysen 11544.

5. **E. adnatus** Levyns Jour. S. Af. Bot. XIII, p. 54. Fig. 1 (1947).

Tetraria gracilis Turrill Kew Bull. p. 73 (1925).

A densely tufted glabrous perennial, 40—130 cm. high, erect or drooping when in deep shade. Leaf sheaths firm; the lamina lacking or minute. Flowering stems slender, wiry, grooved. Inflorescence lax or congested; spikelets few to several, usually exceeded by the lowest leafy

bract. Spikelets linear or lanceolate, compressed, brown, 10 mm. long or less: the bracts obtuse, acute or acuminate. Sterile bracts 5 to 7. Fertile bracts 2 or 3. Supra-floral axis adnate to the bract. Fruit almost globose or ellipsoidal, obscurely trigonous, smooth and shining, sessile, pale brown. (Fig. 1 C.)

TYPE. Esterhuysen 12938. (Bolus Herbarium.)

HABITAT. Damp places at altitudes from 180 to 1,670 metres.

The form occurring at high altitudes on the mountains in the west have spikelets which are broader, shorter and more laxly arranged than those in the east. However, the two forms merge into one another and for this reason no attempt is made to sub-divide the species. *E. adnatus* is closely related to *E. dregeanus* from which it differs in the more slender vegetative parts, the more laxly arranged spikelets and the fruit.

WORCESTER. Milner Peak, Hex River Mountains: Esterhuysen 14863. Du Toits Kloof: Esterhuysen 15679.

PAARL. Above Du Toits Kloof: Stokoe s.n.

STELLENBOSCH. Jonkershoek Twins: Esterhuysen 18489. Jonkershoek: Esterhuysen 15222.

CAPE. Table Mountain: Esterhuysen 12938, 12629, 16809.

MOSSEL BAY. Robinson Pass: Laughton 111 (partly).

GEORGE. Kaaimans River: Wilman (24199 in the Bolus Herbarium).

KNYSNA. Brackenhill Falls: Levyns 7861. Spaarenbosch: Levyns 7868. Noetzie: Levyns 9642.

UNIONDALE. Blaauwbosch Pass: Fourcade 2816. (Type of *Tetraria gracilis* Turrill.)

HUMANSDORP. Witte Els Bosch: Fourcade 1374; Esterhuysen 6743. Storms River Bridge: Levyns 10245, 10483.

6. **E. lucidus** (C.B.Cl.) Levyns comb. nov.

Tetraria lucida C.B.Cl. Fl. Cap. VII. p. 759 (1900). *Epischoenus eriophorus* Levyns Jour. S. Af. Bot. XIII. p. 56. Fig. 2 A—D (1947).

A glabrous perennial about 60 cm. high. Lamina of the leaves lacking. Flowering stems fairly stout, terete or somewhat flattened, bearing few to several crowded spikelets clasped by the leafy bracts. Spikelets about 15 mm. long, narrowly lanceolate. Bracts 12—16, all but the 2 or 3 uppermost sterile, the lower acuminate, the upper somewhat obtuse, brown with pale scarious margins, each with an apical tuft of wool, the woolliness extending downwards for a short distance along the margin. Supra-floral axis shortly adnate to the bract. Ovary narrowly ovoid, the apex obtuse, minutely downy. Fruit, according to C. B. Clarke, obovoid, black-brown, crowned by the long pyramidal style base.

TYPE. Schlechter 9987 (Kew).

HABITAT. Damp places at altitudes from 900 to 1,700 metres.

CERES. Prince Alfred: Schlechter 9987. Cold Bokkeveld: Levyns 9362A. Elands Kloof: Levyns 8142.

WORCESTER. Wellington Sneeuwkop: Esterhuysen 26497.

7. **E. complanatus** Levyns sp. nov. (Fig. 3 A—C.)

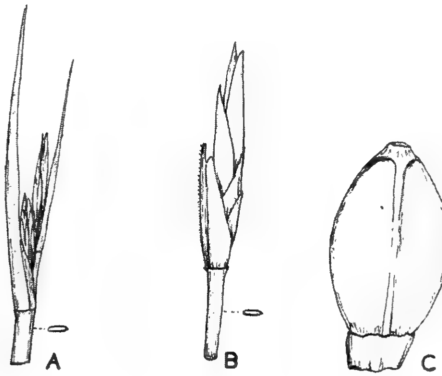


FIG. 3.—*Epischoenus complanatus.*
A. Inflorescence. Natural size.
B. Spikelet. × 2½.
C. Fruit. × 10. (Drawn from Esterhuysen 26496.)

Herba perennis caespitosa glabra caulibus complanatis. Folia omnia basalia, lamina nulla vel complanata. Inflorescentia congesta, spiculis erectis. Bractea infima inflorescentia longior. Spiculae 10—14 mm. longae, complanatae. Glumae distichae, 3—4 inferiores vacuae. Flores 2—3, inferiores mares et supremus bisexualis. Rachilla ultima bractea leviter adnata. Nux ellipsoidea trigona fusca lucida, disco amplo.

A tufted glabrous perennial, 20—65 cm. high, with or without green leaves. Leaf sheath laterally compressed; lamina, when present, firm, flat, 4—6 mm. wide, usually shorter than the inflorescence. Flowering stems flattened, similar to the leaves, 3—5 mm. wide, bearing near the apex 2 to 3 leaf-like bracts, the lowest at least longer than the spikelets. Spikelets 10—14 mm. long, pale brown, erect, partly hidden by the sheathing bracts, the pedicels flattened or none. Spikelet with 3—4 acute or somewhat acute sterile bracts at the base, then 1—2 bracts with male florets, finally a bract with a bisexual floret. Supra-floral axis slightly adnate to the bract. Fruit ellipsoidal, dark brown, shining with a small

beak from which 3 ribs run downwards becoming faint below the middle; seated on a pale, well developed disc.

TYPE. Esterhuysen 26496 (Bolus Herbarium).

HABITAT. Damp sheltered places on mountains at altitudes from 900 to 1,850 metres.

TULBAGH. Great Winterhoek: Esterhuysen 19781, 26989.

WORCESTER. Mostert Hoek Twins: Esterhuysen 24267. Chavonnesberg: Esterhuysen 8181. Wellington Sneeuwkop: Esterhuysen 12438, 24366, 26496. Slanghoek Mountains: Esterhuysen 9456, 17776.

PAARL. Witteberg: Esterhuysen 27610. Wemmershoek: Esterhuysen 11575. Paardekop: Esterhuysen 11593.

CALEDON. Moordenaars Kop: Stokoe 9116. River Zondereinde Mountains: Stokoe 2162. Somerset Sneeuwkop: Stokoe 5000. Landrost Kop: Stokoe 2851.

8. **E. cernuus** Levyns sp. nov. (Fig. 4 A—D.)

Herba perennis caespitosa glabra caulibus gracilibus. Folia basalia graminea quam caules breviora. Inflorescentia laxa bracteis foliaceis, spiculis cernuis. Spiculae 8—15 mm. longae. Glumae infimae 6—7 vacuae. Rachilla supra florem bisexualem minuta. Nux oblonga pallida tuberculata stipitata.

A tufted perennial, 40—50 cm. high. Stems very slender, terete, erect. Basal leaves 6—20 cm. long; lamina grass-like, dry curled and wiry by the time the spikelets are mature: sheath pale, splitting almost to the base, leaving weak threads along the torn edges. Flowering stems with several distant nodes, each bearing 1—4 spikelets, nodding on capillary pedicels, the lowest node often without spikelets. Leafy bracts at the nodes erect, slender, the lowest more than half the length of the flowering stem, the upper progressively shorter. Spikelets terminal, solitary or in pairs. Spikelet 8—15 mm. long, pale brown. Sterile bracts 6—7, the lowest shortly aristate, the others acuminate or acute. Fertile bracts 2. Supra-floral axis and rudimentary bract shorter than the ovary, frequently minute. Ovary stipitate, tuberculate in the upper half, with a crown of short hairs at the base of the style. Fruit oblong, scarcely trigonous but with 3 longitudinal ribs, pale brown, stipitate, prominently tuberculate in the upper third, rugose-tuberculate below, becoming almost smooth at the base.

NOTE. This species forms a link between Epischoenus and Tetraria. The supra-floral axis is here smaller than in any other species and it shows little of the characteristic thickening which occurs after fertilisation in other members of the genus. Its vegetative characters also suggest an affinity with Tetraria. However, the supra-floral axis though small,

FIG. 4.—*Epischoenus cernuus.*
A. Part of an inflorescence. $\times \frac{1}{2}$.
B. Spikelet. $\times 2\frac{1}{2}$.
C. Gynoecium. The range of size of the prolongation of the axis beyond the bisexual floret is shown alongside. $\times 10$.
D. Fruit. $\times 10$.

is invariably present and this feature has been recorded in no species of Tetraria.

TYPE. Levyns 8873 (Bolus Herbarium).

HABITAT. Damp sandy places at altitudes from 180 to 1,530 metres.

CLANWILLIAM. Krom River: Esterhuysen 17982.

CERES. Schurfteberg Pass: Esterhuysen 17377.

WORCESTER. Witteberg Slanghoek: Esterhuysen 16515.

TULBAGH. Mountains above Twenty Four Rivers: Esterhuysen 21897.

PAARL. Bullers Kop, Drakenstein: Esterhuysen 11907.

STELLENBOSCH. Steenbras: Levyns 8873.

CALEDON. Hangklip Estates: Levyns 9387.

ACKNOWLEDGMENTS.

The author wishes to acknowledge her indebtedness to the University of Cape Town for the facilities provided for research and for access to the plant collection and library of the Bolus Herbarium. She also wishes to thank Mr. E. Nelmes who, through the courtesy of the Director of Kew, verified a matter of typification.

NOTES ON THE GENUS CRASSULA, II

By Vera Higgins.

SECTION IV. CAMPANULATAE.

Perforata Group.

Names which have been confused in the literature and in cultivation are *Crassula perfossa* Lam. and *Cr. rupestris* Thunb. with which are associated *Cr. perforata* Thunb., *Cr. punctata* L. and *Cr. punctata* Mill. Schonland recognises two species:

Cr. perforata Thunb. (syn. *Cr. perfossa* DC. (Pl. Gr. t.25) non Lam.).

Cr. rupestris Thunb. (syn. *Cr. perfossa* Lam., *Cr. perfilata* Scop., *Cr. punctata* Mill. and *Cr. monticola* N.E.Br.).

The specific names are correct but the synonymy is confused.

Crassula perforata Thunb.

This species was described by Thunberg in *Nova Acta Acad. Caes. Natur. Cur.* VI (1778): *foliis connato-perfoliatis, ovatis, ciliatis, remotis; caule erecto thyrsifloro.* He found the plant in woods near Swartkops Zoutpan. Linnaeus fils, in the *Supplementum* (1781) omits *ciliatis* and says the inflorescence is *pedunculato-subverticilatis.* Willdenow in his edition of *Species Plantarum* (1797) quotes both Thunberg and Linnaeus fils and in *Enumeratio Plantarum horti regni botanicum Berolinensis* (1809) gives as synonyms *Cr. perfossa* DC and *Cr. perfilata* Scop.

There is no doubt about the identity of *Cr. perforata* Thunb.; it is an erect-growing plant with the thickened, ovate leaves so closely united that they appear to be threaded at intervals up the stem which terminates in a long, interrupted thyrsus with small yellow flowers.

Crassula rupestris Thunb.

Thunberg described this species, which he found at Roggeveld near the Hex River, in *Nova Acta Acad. Caes. Natur. Cur.* IV (1778) also; *foliis connatis, ovatis, integris, glabris, caule tecto; corymbo supradecomposito.* This description was repeated by Linnaeus fils, Lamarck, Willdenow and De Candolle with little or no alteration except that the colour of the flowers was later given as white. In *Flora Capensis* (1862) Harvey gives this species in his list of "Doubtful species unknown to us", although

it is a common plant at the Cape. This plant cannot be confused with *Cr. perforata* since the inflorescence is quite distinct, being a compact corymb terminating each stem.

When describing *Cr. rupestris* Thunb. in *The Flowering Plants of South Africa* XXI, t.839 (1941), Dr. R. A. Dyer says: "For many years *Crassula rupestris* was known by the name *Cr. perfossa* Lam. under which it was referred to by Harvey in *Flora Capensis.* The older name given to the plant by Thunberg was restored by Schonland." The correct name was certainly brought back into use but the fact that *Cr. rupestris* Thunb. and *Cr. perfossa* Lam. were not the same plant was not made clear.

An examination of Harvey's description of *Cr. perfossa* Lam. seems to indicate that parts of two descriptions have been combined, whether intentionally or by some error of transcription it is not possible to say; the leaves are described as "connato-perfoliate", an expression used by Thunberg for *Cr. perforata*; Lamarck in describing *Cr. perfossa* uses a similar expression—"connées et enfilées par les tiges", but the inflorescence is given by Harvey as "cymes lateral, subsessile, dense, oblong or globose" which is not the long interrupted thyrsus of *Cr. perforata* with which *Cr. perfossa* is closely allied if not identical.

Crassula perfossa Lam.

The description by Lamarck appeared in *Encyclopédie Methodique,* II, p. 173 (1786) but he had not seen the flowers. An illustration was given in the *Supplement* to the above by Poiret (1811) and he regarded the species as synonymous with *Cr. perfilata* Scop. which there is no reason to doubt. Although there are no early illustrations of *Cr. rupestris* or of *Cr. perforata*, there are several of *Cr. perfossa*; Poiret's is a rather poor line drawing but Scopoli gives a good plate in *Deliciae florae et faunae insubricae* (1788) which shows a plant very similar to *Cr. perforata* Thunb.; N. J. Jacquin in *Plantarum rariorum Horti Caesari Schoenbrunnensis* t.432 (1804) shows the same plant, growing rather more prostrate, under the name *Cr. perfossa* Lam. with *Cr. perfilata* Scop. as synonym. In *Plantes Grasses*, De Candolle has a plate (t.25) of the same plant with the same synonym. Clearly at the time these two names were regarded as synonymous but in 1809 Willdenow in *Enum. plant. horti regni bot. Berolinensis* also gave as a synonym the name of *Cr. perforata* Thunb. Haworth in *Synopsis Plantarum Succulentarum* (1812) gives as synonyms of *Cr. perfilata* Scop. (which he uses in preference to Lamarck's earlier name) *Cr. perfossa* DC. and *Cr. punctata* Mill., whilst under *Cr. punctata* L. he excludes Miller's plant of the same name. This brings us to yet another specific name.

Crassula punctata L.

The first description of this species is given in *Systema Naturae*, 10th ed. 1759: "*C. fol. oppositis ovatis gibbis ciliatis supra planis punctatis*" which could apply to a number of plants especially as no mention in made of the flowers. In *Species Plantarum*, 2nd ed. 1762, the flowers are still not described but *Cr. punctata* Mill. is quoted as a synonym; in Willdenow's edition of *Species Plantarum* (1797) the words "*floralia ovata*" are added to the description and Miller's plant again given as a synonym but, as has been mentioned, Haworth did not regard these plants as synonymous; in fact, he thought *Cr. punctata* Mill. was the same as *Cr. perfilata* Scop.=*Cr. perfossa* Lam. whilst listing *Cr. punctata* L. as a separate plant.

Crassula punctata Mill.

Miller first described his *Cr. punctata* in the 7th edition of his *Gardeners' Dictionary* in which the Linnaean binomial system was not in use, so that the description in the 8th edition should be used; this reads: *caule flaccido, foliis connatis, cordatis, succulentibus, floribus confertis terminalibis* and in the English text that follows he says that the stems "are terminated by clusters of small white flowers, sitting very close to the top of the stalks", in fact, *Cr. punctata* Mill. is *Cr. rupestris* Thunb.

What *Cr. punctata* L. is, it is hard to say; Lamarck, when describing *Cr. perfossa*, had already suppressed the name as it did not appear to fit his plant and it is difficult to say now whether it was intended to apply to *Cr. perforata* Thunb. or not. Schonland seemed to be in doubt if *Cr. punctata* L. and *Cr. punctata* Haw. were the same plants and suggested that they belonged under *Cr. ramuliflora* Link et Otto; I have seen Haworth's drawing in the Kew collection and it appears to me to represent a young plant of *Cr. perforata* Thunb. but it is named *Cr. punctata* Haw.; it has been raised from seed sent by Bowie in 1821.

If Miller had been the first to use the name *Cr. punctata* (1768), it would have had priority over *Cr. rupestris* Thunb. (1778) but the specific name had been used earlier by Linnaeus (1759) for a plant whose identity is now uncertain, therefore the name *punctata* is best abandoned.

It has been mentioned that Willdenow regarded *Cr. perforata* Thunb. and *Cr. perfossa* Lam. as synonymous; this was not accepted by Roemer et Schultes nor by De Candolle in his *Prodromus* but it is probably correct. *Cr. perforata* is a variable species in nature and, though I have not seen a form which has quite such thick leaves as *Cr. perfossa*, the differences are so slight as to be varietal rather than specific.

Crassula monticola N.E.Br.

This is the other name included in the synonymy of *Cr. rupestris* Thunb. by Schonland; a rather small variety of *Cr. rupestris* goes under this name in cultivation but it does not fit the description particularly well. Twenty years ago I received (indirectly) from Kew a plant under the name *Cr. montis-draconis* Dint. but that plant has yellow flowers and belongs to the *Sphaeritis Section.* The plant in question is certainly a form of *Cr. rupestris* Thunb.; the leaves are shorter and broader than some forms and so thick that the upper surface is somewhat convex as well as the lower; the flowers are pink and rather large for the species but agree with Dr. N. E. Brown's dimensions, in fact it seems to agree with his description of *Cr. monticola* so that it may well be a descendant of the plant he described and the erroneous name under which it was received could be a corruption due to a damaged label.

Conclusion: The correct synonymy should be:

Cr. perforata Thunb. (syn. *Cr. perfossa* Lam., *Cr. perfilata* Scop.).

Cr. rupestris Thunb. (syn. *Cr. perfossa* Harv. non Lam., *Cr. punctata* Mill., *Cr. monticola* N.E.Br.).

Cr. rupestris Thunb. has a very wide distribution. Marloth, in *Flora of South Africa*, p. 22, says: "This is a common shrub of the Karroo, from Worcester to Laingsburg and Oudtshoorn, being about one to two feet high. It varies according to locality and one of its forms, which occurs on the cliffs of Table Mountain and Muizenberg, is a much smaller and straggling plant but in foliage and flowers identical with the type from the Karroo." Schonland gives a more easterly extension of its range to near Grahamstown and says: "Frequent variations in the shape and size of the vegetative organs occur." These variations are, indeed, so great that the forms from opposite ends of the range have diverged so far as to appear at first glance distinct species.

Of the plants of *Cr. rupestris* that I have in cultivation, a number have been collected in the wild and their locality is known and recorded; for these I am indebted to Dr. R. A. Dyer, Mr. F. R. Long and Mr. H. Hall and their help is much appreciated. It would appear that the type occupying the eastern end of the range of distribution, as exemplified by plants collected at Plutos Vale, 17 miles from Grahamstown (J. Erens 1978, 10/12/46) sent by Dr. Dyer (Fig. 1) and a similar plant from near Steytlerville sent by Mr. Hall, has the largest leaves; these are glaucous blue, cordate, the lower side convex, the upper side convex near the stem but flat towards the tip; the flowers are generally white. The type common in the Karroo (Fig. 2) has rounder, thicker leaves which are green or slightly glaucous, with a marked red edge, sometimes with

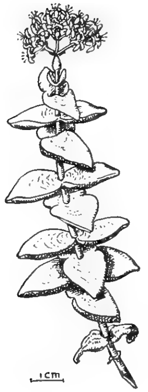


FIG. 1.—*Crassula rupestris* Thunb. (coll. J. Erens 1978, 10/12/46, Plutos Vale, 17 miles from Grahamstown). Leaves glaucous, flowers white.

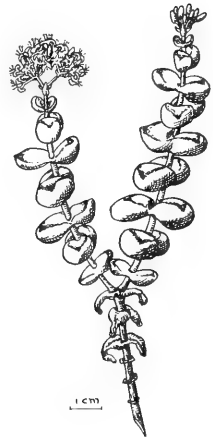


FIG. 2.—*Crassula rupestris* Thunb. (coll. H. Hall). Common form in the Karroo. Leaves greenish glaucous, edges red; flowers pink.

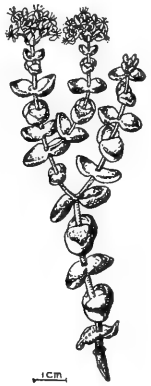


FIG. 3.—*Crassula rupestris* Thunb. (coll. H. Hall, near Barrydale). Small form: leaves green, edges red, dotted; flowers pink.

FIG. 4.—*Crassula perforata* Thunb. (coll. F. R. Long, near Alice). Leaves narrow, thick, no cilia.

dots also, and with pink flowers. A form with much smaller leaves which are green with red dots and edges also occurs here (Fig. 3); Mr. Hall reported that he saw two or three such bushes amongst the dominant *rupestris* on north-facing slopes near Barrydale. A similar small form was collected by Mr. Hall in the Montagu district but the leaves are rather bluer and the flowers white.

Cr. rupestris Thunb. is an excellent example of a species which shows considerable variation throughout its range without sufficient variation in essential characters to warrant splitting it into distinct species; it would be difficult even to select varietal forms for they intergrade continually and the population should be studied as a whole. The difference in habit between erect and prostrate plants is usually due to the thickness and consequent weight of the leaves. It would be interesting to know how isolated specimens appearing amongst an otherwise fairly uniform population arise, whether as mutations or by cross-breeding of plants showing some varietal differences.

In cultivation the plants remain true to type; when plants differ in size and colouring and, to a small extent, in time of flowering they may need distinguishing names in which case fancy, not botanical, names should be given.

Cr. perforata Thunb. is also somewhat variable in nature, the chief differences being in the proportionate length of the leaf, the thickness, the presence or absence of cilia along the edge and the position of the leaf which is horizontal but in some cases with the tip slightly or markedly deflexed. The stems are erect when young and may remain so, especially if supported by surrounding bushes, or they may fall over and will then root when in contact with the ground. Three plants sent by Mr. F. R. Long showed the chief distinctions found in the leaf; the narrowest was a specimen from Alice (Fig. 4) whose leaves were considerably longer than broad and the edge without cilia, whilst a specimen from Zuurberg was rather wider with short cilia and another, from Uitenhage (Fig. 5), was as broad as long and markedly ciliate. Plants sent by Dr. Dyer show similar deviations. The inflorescence, which is a long interrupted thyrsus, is similar in all specimens, the chief difference being in the length of the pedicels. My first specimens of this plant, of unknown origin but probably from an old collection in this country, agree entirely with Thunberg's description.

Cr. perfossa Lam., if my specimen (Fig. 6) fairly represents this species, varies from *Cr. perforata* Thunb. in the greater thickness of the leaves, which are without cilia and rather more glaucous; the flower is identical and so is the type of inflorescence. The plant most nearly resembling this that I have received from South Africa was a specimen sent by Dr. Dyer from near Calitzdorp which, unfortunately, failed to root.

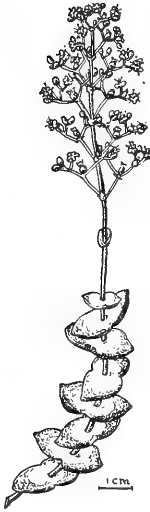


Fig. 5.—*Crassula perforata* Thunb. (coll. F. R. Long, Uitenhage). Leaves wide, thin, ciliate.

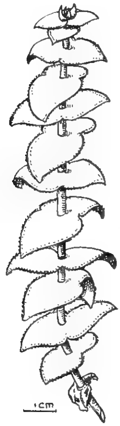


Fig. 6.—*Crassula perfossa* Lam. Origin of specimen unknown. Leaves thick, no cilia.

Crassula conjuncta N.E.Br.

In 1902 Dr. N. E. Brown gave this name to a plant sent to Kew by Prof. MacOwan from South Africa in 1896 but the exact locality is not given. In 1910 Dr. Schonland described under the name *Cr. patersoniae* a species which had been collected in 1902 by Mr. E. E. Galpin near Port Elizabeth and in 1909 by Mrs. T. V. Paterson at Bethelsdorp. Later, he regarded the two names as synonymous but, from the description of the inflorescence, they do not appear to be identical.

In his description (Gard. Chron. XXXI, 1902), Dr. Brown says that *Cr. conjuncta* is nearly allied to *Cr. perforata* Thunb., the distinguishing points being: "The leaves are always concave above, never flat or convex, nor recurved as they frequently are in *C. perforata*; they are of a lighter glaucous-green, and the ciliation on their margins is rather longer and denser. The inflorescence is narrower and much more compact, the cymes of which it is composed having much shorter stalks, and the flowers are larger and pure white, not dull yellow as in *C. perforata*." Dr. Schonland, on the other hand, says of *Cr. patersoniae*: "It is very closely allied to *Cr. perforata* Linn. f. [? *perforata*] from which it can be

distinguished at a glance by its shorter and much looser inflorescence which almost resembles a corymb."

I received in 1940, under the name *Cr. conjuncta* N.E.Br., a plant (Fig. 7) which exactly fits the description; since it came indirectly from

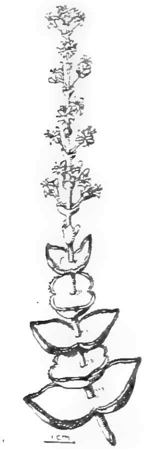


FIG. 7.—*Crassula conjuncta* N.E.Br.

FIG. 8.—*Crassula ? patersoniae* Schonl. (coll. H. Hall, near Steytlerville).

Kew it is probably a propagation from the plant from which the description was made; the inflorescence is a long interrupted thyrsus with white flowers. In 1948 I received from Mr. Hall two plants collected by him, one at Steytlerville (Fig. 8) and the other on a small hill overlooking Fish Hoek on the Peninsula; in both cases I noted on arrival that the leaves resembled *Cr. conjuncta* N.E.Br. in shape and colour but were not so closely united, nor had they the ciliate edge. When they flowered, the inflorescence was a corymb, as in *Cr. rupestris* Thunb. but, instead of being close to the upper pair of leaves, there was a distinct scape 5—6 cm. long bearing 7—8 pairs of bracts. This is probably the plant which Dr. Schonland named *Cr. patersoniae*; I had regarded these two specimens as possible hybrids between *Cr. rupestris* and *Cr. conjuncta* when they first flowered here. Though they came from distinct areas, they are very similar in many ways but the plant from Steytlerville has red dots on the upper surface of the leaves which, in both specimens, are

glaucous blue with a conspicuous red edge (like *Cr. conjuncta*) but without the cilia on the margin. Further field work would be necessary to decide the connection between *Cr. conjuncta* N.E.Br. and *Cr. patersoniae* Schonl.; in his description Dr. Brown did not give the precise locality or area of distribution of the former.

Crassula pearsonii Schonl.

This name was proposed by Dr. Schonland for *Cr. brevifolia* Harv. which he regarded as unsuitable. Prof. R. S. Adamson has shown in the *Journal of S. African Botany*, VIII, pt. 4, 1942, that this name change is not valid and the correct name for the plant remains *Cr. brevifolia* Harv. In *Flora Capensis* Harvey says: "Nearly allied to *perfossa* [i.e. *rupestris* Thunb.] but differs in the shape of the leaves and their evidents connation." In cultivation a small form of *Cr. rupestris* sometimes goes under the name of *Cr. brevifolia* which is incorrect; the true species has leaves which are longer than broad, trigynous, flat above and concave below. The flowers are white and the corymb (at least in specimens I have seen) is not so large or close as is usual in *rupestris*.

Two new species, which belong to this group, have been described recently: *Cr. marnierana* Huber et Jacob. and *Cr. nealeana* Higgins.

Cr. marnierana was described by Huber and Jacobsen in *Cactus* No. 31, 1952, Supplement p. 8. In 1949 I received specimens of this plant from Mrs. Bolus and from Mr. Hall under the name and number "Herre 5470" but with no details of locality, and also from Herr Jacobsen who then said it had been collected at "Lategaansvlei, Oudtshoorn". In the published description, the habitat is given as "S.W. Africa, locus incertus —coll. Lategan—e collectione W. Triebner—Windhoek No. 102"; it is also said that the plant is related to *Cr. perforata* Thunb., which is only true in that both belong to the *Perforata Group*; it is much more closely related to *Cr. rupestris* Thunb., being a smaller, more prostrate plant, with very short internodes and a sessile corymb of small white flowers.

Cr. nealeana Higgins has been in cultivation in England for nearly thirty years under the names "Cr. rupestris minor" and "Cr. perfossa minor", but it is a distinct species which I have described (*National Cactus & Succulent Journ.*, Vol. X, 2. 1955) and named after W. T. Neale, of Newhaven, who received the plant from South Africa some time before 1935. The chief distinction from *Cr. perforata* Thunb. is in the smaller size and prostrate habit and in the short, thyrsus-like inflorescence of yellow flowers which is determinate, unlike the long, indefinite interrupted thyrsus of *Cr. perforata*.

Crassula sladeni Schonl.

A plant from Little Namaqualand was described by Dr. Schonland under this name in 1912; he says: "This species resembles and is allied to *Crassula lactea* Ait. from which, however, it differs in the shape of the inflorescence, and especially in the floral structure"; he placed it in *Section Stellatae, Lactea Group.*

Mr. Hall sent me a flowering specimen of a large shrubby Crassula from the Richtersveld which clearly belonged to the *Perforata Group,* the corymbose inflorescence and the flowers bearing a marked resemblance to *Cr. rupestris* Thunb. but differing in the form of the leaves. Later Mr. Hall reported that he had seen the plant at Stellenbosch where it was labelled *Cr. sladeni* and it appears to agree with the description of this species given by Dr. Schonland except that the petals in my specimen each had a small mucro and the original description says "Petala . . . sine mucrone". Where the mucro is not well developed its presence or absence in different specimens seems variable and, since this is the only obvious distinction, it seems that *Cr. sladeni* Schonl. should be transferred to the *Perforata Group* of *Section Campanulatae.*

VARIATIONS OF TEMPERATURE IN MALE CONES OF ENCEPHALARTOS ALTENSTEINII LEHM.

By

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A fact which has been known to the writer since early childhood is that the male cones of at least one species of *Encephalartos* show a considerable rise in temperature during the period of pollen shedding. It is not now possible to say with certainty which species supplied the evidence, but the plant was probably one growing in or near Durban, and may have been in the Botanic Gardens there. Knowing that the cones become heated during the liberation of pollen, it was somewhat of a disappointment to find, on going through the literature available, only one reference to this phenomenon, a brief remark in *Les Gymnospermes actuelles et fossiles*, by H. Gaussen. This remark is to the effect that the cones have a feverish temperature, and there is no indication as to where the information had been obtained.[1] Other works ignore the matter entirely.

Male cones were cut off two plants of *Encephalartos altensteinii* Lehm., for use in the practical classes for students in the second and third year botany courses at Rhodes University, Grahamstown, during April, 1958, and observations made of the temperature changes. This was done at first merely as a possible demonstration of the rise, known to the writer to occur, and to show how great it is—most aptly described by Gaussen, in the work already referred to, as "le cône présente une veritable fièvre". It was, as was later found out, a most fortunate chance that *E. altensteinii* was chosen, as, of the species available, it was the most suitable. When discussion with various workers whose knowledge of *Encephalartos* and allied genera greatly exceeds that of the writer, showed that apparently no one had much, if any, idea of this temperature rise, observations were made on a number of cut-off cones of *E. altensteinii* in the laboratory and cones *in situ* on plants in the Botanic Gardens of Grahamstown, where the first lot of cones had come from. It was not practicable to carry out full-scale observations out of doors with the delicate thermometers being used, but better methods of measuring the internal temperatures of plants are available by other means and it is hoped to employ these later.

Ordinary glass laboratory thermometers registering up to 100 degrees C. were used: these were inserted between the sporophylls of the cones at various positions from base to tip and a control thermometer was placed next to the cones, neither touching them nor close enough to be materially affected by any radiated heat, but registering the air temperature in the vicinity of the cones. The expected rise in temperature was duly observed, and it was then noticed that it apparently follows a diurnal rhythm, a fact not mentioned by Gaussen, and one which also may serve to explain in part why the temperature rise has been overlooked by most workers. There is also a possibility that there is a strong connection between the temperature rise and the actual shedding of pollen: it would seem that pollen is shed very freely during the afternoon hours, when the temperature of the cones is at the highest level (see tables), but if as much as possible of the pollen is shaken off at about six o'clock in the evening, apparently only a little is shed from then until after noon on the following day. It is also possible that what does seem to be shed then is only what was trapped the day before and released owing to movements of the sporophylls or of the various insects which infest the cones. (At least three species of weevils were common in the male cones of *E. altensteinii* used, and a tenebrionid beetle was found in great numbers in most of the cones. The dimorphic weevil, *Antliarrhinus zamiae* Thunb. (*Antliarrhinus rectirostris* Gyl.) was common on female cones of *E. horridus* Lehm. only, at the time when a gelatinous exudate appeared: otherwise, very few of this type of weevil were seen.)

The temperature of a cone is not the same over all its length; the greatest rise and hence the greatest difference between cone temperature and air temperature occurs, as far as has been observed, about the middle third of the cone, and it would seem that there may be a gradual progression of the maximum temperature zone further up the cone, towards the apex, during the course of pollen shedding. The observations made have been of a preliminary nature and on cones already fairly far advanced in growth at the pollen shedding stage, but the tables given below show clearly the diurnal rhythm and the position of greatest temperature rise. The greatest difference noted for any cone at any time, as compared with air temperature, was one of 17 degrees C. in the laboratory, the cone having been cut from the parent plant four days before. In the open, with the cones still attached to the parent plant, the difference, on a windy day, was on one occasion 10 degrees C.

The male cones of *E. Lehmannii* Lehm. were also tested but though in the field they appeared to show a difference between parts of the cone and the surrounding air, as tested roughly by feeling with the hand, the results from these cones in the laboratory do not produce the striking

differences that are obtained with the cones of *E. altensteinii*. The rise is often so great in the latter that, compared with the air in the afternoon hours, the cone feels hot to the hand, and it is also possible to distinguish with ease which area is warmest, over a period of several days in the laboratory.

The plants from which the first supply of *E. altensteinii* cones were obtained are a clump of six, one of which has a trunk about 10 feet tall, the rest being grouped round its base and being almost stemless. The large plant bore four cones and the smaller plants three, three, two, one and no cones, respectively. The cones were ripe at various dates from late March into early May and at the beginning of July two had not yet entirely lost their yellow and green colouring, but showed no temperature rise. They averaged 17 inches in length, including the peduncle, but later cones obtained through the kindness of Mrs. J. Rennie, from other *Encephalartos* plants growing elsewhere in Grahamstown, averaged 24 inches. These cones appeared to be of the *E. altensteinii* type and the description given of the plants fitted *E. altensteinii* also, so that the cones were considered of this species in the tests.

Of the great number of *Encephalartos* plants growing in Grahamstown, only two groups are known to the writer to have borne female cones during the first half of 1958. Male cones were produced by perhaps twenty plants and the rest showed no signs of cone production whatever.[2] The female cones belonged to *E. altensteinii* and *E. horridus* Lehm. There does not seem to be anything approaching the same temperature rise and fall in the female cones, as in the male cones of *E. altensteinii*, but testing of the female cones is not possible with ordinary thermometers without damaging the cones.

All the cones tested, of *E. altensteinii* and *E. villosus* Lehm., had a peculiar and distinctive, strong, but not particularly unpleasant, smell; those of *E. lehmannii*, however, had no apparent odour. This is contrary to the experience of Miss Pegler[3] with the cones of *E. villosus* in the open. During the tests of the cones of *E. villosus*, negative results were obtained for temperature rise, as was to be expected, owing to the extremely loose, open construction of the cone and the simple methods used for taking the temperatures.

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(3) PEARSON, H. H. W. (1906): Notes on South African Cycads—I. *Trans. S.A. Phil. Soc.*, Vol. XVI, Part 4, pp. 341–354.
(4) LEICK, E. (1910): Untersuchungen über die Blütenwärme der Araceen. Griefswald. p. 9. „ . . . die überraschend hohen Temperaturen der Araceen blütenstände, sowie ihre eigenartigen Wärmeschwankungen, die höchstens noch in dem Verhalten der Cycadeen-infloreszenzen und der Victoria regia." Further, p. 56. „Es muss aber betont werden, dass Temperaturüberschusse von gleicher Höhe wie bei den Araceen nur bei einigen Cycadeen Palmen und bei Victoria regia ermittelt werden."
(5) LEICK, E. (1915): Berichte der deutschen botanischen Gesellschaft. Band XXXIII. p. 519: Leick states that Cycads, Palms and Victoria regia „ähnlich hohe Eigenwärmegrade gemessen wurden wie bei den Araceen."
(6) HUBER, B. (1935): Der Wärmehaushalt der Pflanzen. *F. Boas, Munchen,* Naturwissenschaft und Landwirtschaft. Verlag Dr. F. P. Datterer & Cie., Freising-Munchen.
p. 89. „Es wird angegeben: für Cycadeen (Kraus 1896): wochenlang anhaltende tagesperiodische Selbsterwärmung der männlichen Blütenzapfen bis zu 13° Übertemperatur; der Zeitpunkt des Tagesmaximums verschiebt sich im verlauf der Blüte gesetzmässig, ebenso verschiebt sich der Zeitpunkt des Maximums von der Spitze (früher) gegen die Basis (später);" p. 90. „Bei den grossenteils windblütigen Cycadeen (über ihre Käferblütigkeit vgl. Diels 1916) und Palmen wird die Erwärmung erst recht eine blosse Begleiterscheinung der raschen Stoffmobilisierung sein, die sich auch im Verschwinden der Stärkeworräte des Stammes und der Entwicklung hoher lokaler Blutungsdrucke äussert."

TABLE I.

Encephalartos altensteinii: male cone, collected 12.4.1958 and left lying on laboratory bench. Large amount of pollen being shed.

Date.	Time.	Temperature, in degrees C.	
		Air.	Cone 1.
14.4.1958	11.30 a.m.	20·0	22·0
	3.0 p.m.	21·0	36·0
	3.30 p.m.	21·0	36·0
	4.30 p.m.	20·0	37·0
15.4.1958	11.0 a.m.	20·0	20·0
	12.30 p.m.	21·0	21·0
	2.15 p.m.	21·0	24·0
	3.0 p.m.	21·0	26·5
	3.30 p.m.	20·5	30·0
	4.50 p.m.	20·5	35·0
	6.10 p.m.	20·0	37·0

TABLE II.

Encephalartos altensteinii: male cones.

Date.	Time.	Temperature, in degrees C. Air.	Cone 2.	Cone 3. Lower.	Cone 3. Middle.	Cone 3. Upper.
16.4.58	8.45 a.m.	—	17·0	—	—	—
	9.30 a.m.	16·0	—	17·0	18·5	18·5*
	10.30 a.m.	17·0	18·0	17·0	18·5	17·0
	11.30 a.m.	18·0	—	18·0	19·0	18·0
	12.10 p.m.	19·0	18·7	18·0	19·0	18·2
	1.0 p.m.	19·5	20·0	19·0	20·0	19·0
	2.10 p.m.	19·6	23·0	20·0	22·0	20·3
	2.23 p.m.	20·0	23·5	20·5	23·0	20·5
	3.15 p.m.	20·0	27·0	22·0	26·0	22·0
	3.32 p.m.	20·4	28·0	22·0	27·0	22·2
	3.45 p.m.	20·4	29·0	22·5	27·8	22·6
	3.57 p.m.	20·3	30·0	22·9	28·3	22·8
	4.10 p.m.	20·0	31·0	23·0	28·5	22·8
	4.40 p.m.	20·0	33·4	23·8	30·0	23·5
17.4.58	9.0 a.m.	18·5	19·0	17·5	18·0	18·2
	10.30 a.m.	19·5	19·0	18·5	19·0	19·0
	11.0 a.m.	19·8	19·8	18·8	19·2	19·2
	11.25 a.m.	20·2	20·2	19·2	19·5	20·0
	12.35 p.m.	21·5	22·8	21·5	21·5	22·2
	1.55 p.m.	22·4	28·0	24·6	26·2	25·5
	4.30 p.m.	22·5	36·8*	28·0	34·5	30·5
	5.40 p.m.	21·5	36·5	29·0	34·0	30·0
	6.0 p.m.	21·2	37·0	28·8	34·0	29·8
18.4.58	6.0 p.m.	22·4	35·0	26·5	30·4	26·4
19.4.58	5.40 p.m.	23·0	33·0	24·5	26·0	24·5
21.4.58	5.0 p.m.	23·0	25·8	23·0	23·4	23·0
22.4.58	5.0 p.m.	20·5	22·0	21·0	21·0	21·0

Hereafter the temperatures were not significantly different.

* Indicates the reading is higher than the following one, during rising temperatures.

TABLE III.

Encephalartos altensteinii: new male cones, collected 22.4.58.

Date.	Time.	Temperature, in degrees C.									
		Air.	Cone 4.			Cone 5.			Cone 6.		
			Lower.	Middle.	Upper.	Lower.	Middle.	Upper.	Lower.	Middle.	Upper.
22.4.58	5.0 p.m.	20·5	26·0	28·5	25·8	27·5	29·0	26·3	27·8	28·0	23·0
23.4.58	9.0 a.m.	20·0	21·0*	21·0	21·0	21·2	21·2	20·8	21·2	21·2	20·4
	11.45 a.m.	20·5	20·0	21·4	21·2	21·5	21·6	21·2	21·5	21·5	21·0
	2.0 p.m.	20·5	23·2	24·2	23·2	24·4	25·0	24·0	25·0	25·2	23·0
	4.0 p.m.	20·0	24·0	26·2	24·2	25·4	27·8	25·4	27·2	27·8	23·0
	4.45 p.m.	20·0	24·0	26·5	23·8	25·2	28·0	25·0	27·4	28·0	22·4
24.4.58	9.15 a.m.	19·6	20·0	20·4	20·0	20·4*	20·5	20·4	20·2	20·0	20·0
	11.15 a.m.	20·2	20·5	21·0	20·8	20·0	21·4	20·8	21·2	21·0	20·8
	4.15 p.m.	22·0	24·8	26·8	25·6	26·8	31·0	27·0	29·8	30·5	25·5
	5.30 p.m.	21·6	25·0	27·2	25·5	26·4	31·6	27·2	30·5	31·5	25·2
25.4.58	2.0 p.m.	22·4	23·4	24·0	24·0	24·8	25·4	24·4	25·0	25·0	24·0
	4.0 p.m.	22·0	24·4	25·5	24·8	25·2	27·5	26·0	27·2	27·2	25·4
26.4.58	Noon	20·5	21·0	21·5	21·0	21·5	21·5	21·8	22·0	22·5	22·5
28.4.58	Noon	21·2	20·5	21·2	21·5	21·5	21·0	21·8			
29.4.58	11.30 a.m.	16·0	15·0	15·5	15·4	16·2	16·2	16·0	Removed for other purposes.		
	12.45 p.m.	18·6	16·0	16·5	16·5	17·0	16·8	17·0			
	2.15 p.m.	18·8	17·0	17·4	17·2	18·0	17·5	18·0			
	4.40 p.m.	18·5	17·5	18·2	18·0	18·5	18·4	18·4			

TABLE IV.

Encephalartos lehmannii: male cones.

Date.	Time.	Temperature, in degrees C.						
		Air.	Cone 1.			Cone 2.		
			Lower.	Middle.	Upper.	Lower.	Middle.	Upper.
3.5.58 ..	10.0 a.m.	18·4	18·0	18·0	18·0	18·0	18·0	18·4
	5.30 p.m.	18·0	18·0	18·0	18·0	18·0	18·0	18·5
5.5.58 ..	5.45 p.m.	15·0	15·8	16·0	16·0	15·4	15·6	16·0
6.5.58 ..	5.0 p.m.	18·0	18·5	19·0	19·0	18·0	18·0	19·0
7.5.58 ..	2.0 p.m.	19·8	19·8	20·2	20·8	—	—	20·6
9.5.58 ..	2.0 p.m.	19·4	20·0	20·2	20·0			
	4.0 p.m.	19·5	20·0	21·4	20·2			
	5.0 p.m.	19·0	20·0	20·5	20·0			
	5.45 p.m.	18·5	19·5	20·0	19·8			

TABLE V.

Encephalartos altensteinii and *Encephalartos villosus*: male cones.

Date.	Time.	Temperature, in degrees C.						
		Air.	*E. altensteinii.*			*E. villosus.*		
			Lower.	Middle 1.	Middle 2.	Upper.	Lower.	Middle.
9.5.58 ..	2.0 p.m.	19·4	26·0	—	24·2	24·0	—	—
	4.0 p.m.	19·5	30·5	31·5	28·5	28·0	18·5	18·0
	5.0 p.m.	19·0	29·8	31·0	28·0	27·5	18·0	18·0
	5.45 p.m.	18·5	27·5	29·5	26·0	25·5	17·5	17·0

TABLE VI.

Encephalartos altensteinii: male cones *in situ* on plants, Botanic Gardens.

Date.	Time.	Temperature, in degrees C.			Remarks.
		Air.	Cone.		
			Lower.	Middle.	
22.4.58 ..	3.0 p.m.	16·2	19·8	20·0	Much wind, exposed position, but in shade of building.
	3.15 p.m.	16·2	19·8	19·4*	
	3.30 p.m.	16·2	20·0	20·0	
25.4.58 ..	3.0 p.m.	19·8	22·6	23·0	Moderately still, slight breeze: plant in shade of building.
	3.30 p.m.	20·2	25·8	27·0	
	3.45 p.m.	20·2	26·8	30·2	
	4.15 p.m.	20·0	24·8	29·0	

The Genus *Codium* (Chlorophyta) in South Africa

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(With Plates II-XVI)

CONTENTS

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THE GENUS *CODIUM* (CHLOROPHYTA) IN SOUTH AFRICA

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(With Plates II–XVI)

SUMMARY

Nineteen species of *Codium* occur along the coast of South Africa and adjacent Mozambique. Each species is described and illustrated in detail, and notes on distribution and habitat are given. Twelve taxa are newly proposed.

INTRODUCTION

The representation of *Codium* in South Africa is rich both in number of species and in the spectrum of variation. A study of *Codium* in only three other areas—Australia, Japan, and Pacific Mexico—could give as complete a picture of the genus. It has been a great pleasure to undertake this investigation. The original blocking-out of species was completed in 1951 as part of a doctoral dissertation at the University of California under the inspirational guidance of Professor G. F. Papenfuss, who, with characteristic generosity, made all of his collections available, together with those of the University of Cape Town ecological surveys of 1937–1940, which had been sent to him for identification. Accumulation of vast quantities of *Codium* from the far corners of the world, for which I am indebted to scores of collectors, necessitated several reviews

of the South African representatives. Miss M. A. Pocock (Rhodes University, Grahamstown), whose South African collections were well represented in material that I studied at Berkeley, in 1953 sent me the largest and best prepared series of collections of *Codium* that I have ever been privileged to study. During the final review of *Codium* in South Africa, Professor W. E. Isaac kindly sent me useful sets of liquid-preserved and dried specimens. The present paper is a taxonomic treatment of those species found along the South African coast from the Orange River on the Atlantic Ocean southward around the Cape of Good Hope and north-eastward to the Limpopo River, Mozambique. Ontogenetic and phylogenetic considerations, which constituted an important part of my doctoral dissertation, have been omitted in large part; they will be presented in a comprehensive systematic account of the entire genus to be published after completion of studies of various geographical groups of species.

HISTORICAL REVIEW

A brief history of *Codium* in South Africa is not only interesting in itself, but it affords an opportunity to give credit to those whose efforts preceded mine. Early collectors returned with examples of most of the common species, which were assigned to one or another European species on the basis of external morphology. Thus, *C. stephensiae* and *C. lucasii* subsp. *capense* were referred to *C. adhaerens*; *C. capitatum*, *C. duthieae*, *C. extricatum*, *C. fragile* subsp. *capense*, and *C. isaacii* to *C. tomentosum*; and *C. platylobium* at times to *C. elongatum*. Prior to 1935 only three endemic species had been described (*C. platylobium*, 1854; *C. tenue*, 1856; *C. stephensiae*, 1932). The richness of South African *Codium* nonetheless was recognized by W. A. Setchell (University of California), who during the period approximately 1925–1935 accumulated large quantities of specimens and information in pursuing his aim to monograph the entire genus. Setchell himself collected in South Africa in 1927 and additional South African material was sent to him by Miss E. Forbes and Miss A. V. Duthie. From his notes, it is clear that he recognized many of the novelties that are described herein, but largely because he was using dried specimens rather than liquid-preserved material, most of Setchell's manuscript species encompassed parts of two or more species. The ecological surveys made by the Zoology Department of the University of Cape Town under the direction of Professor T. A. Stephenson served as a stimulus to the study of *Codium* by providing many excellent collections. Professor Papenfuss identified the collections of 1937–1940 and, like Setchell, recognized many of the new species described in this paper.

EXPLANATION OF FORMAT

An attempt has been made to check all references to South African *Codium* by examining specimens upon which the records were based. Records thus checked appear under the proper species, and the specimen upon which the record was based is cited, or an alternative basis for identification is indicated (e.g., inference from description or locality). Records listed without supporting citations of specimens are those which I deem reliable in consideration both of the reliability of the author and of the distinctness of the species. Records for which specimens have been sought but have not been located are listed at the end of the paper.

Excluded records are documented in a similar manner. All records of European species (i.e., *C. adhaerens*, *C. bursa*, *C. decorticatum* [=*C. elongatum*], and *C. tomentosum* [=*C. dichotomum*]) may safely be excluded.

The lists of representative collections examined are intended to convey details of geographic distribution. Collections are listed geographically in counterclockwise order from South West Africa around the Cape to Mozambique. River mouths refer to rocky outcrops or headlands near the actual mouths except in the case of *Codium tenue*, which grows in estuarine environments. Herbaria are abbreviated as follows: AD (State Herbarium of South Australia, Adelaide); AG (Agardh Herbarium, housed in the Botanical Museum, Lund); B (Botanisches Museum, Berlin); BM (British Museum [Natural History]); BOL (Bolus Herbarium incorporated into the Department of Botany, University of Cape Town, in 1955); CT (Department of Botany, University of Cape Town); FI (Istituto Botanico, Firenze); G (Conservatoire et Jardin botaniques, Genève); HBG (Staatsinstitut für allgemeine Botanik, Hamburg); K (Royal Botanic Gardens, Kew); L (Rijksherbarium, Leiden); M (Botanische Staatssammlung, München); MAP (personal herbarium of M. A. Pocock, eventually to be incorporated into the Herbarium of the Albany Museum, Grahamstown); NY (New York Botanical Garden); PC (Muséum National d'Histoire Naturelle, Laboratoire de Cryptogamie, Paris); RU (Rhodes University, Grahamstown); S (Naturhistoriska Riksmuseum, Stockholm); SAP (Botanical Institute, Hokkaido University, Sapporo); TCD (Trinity College, Dublin); UC (University of California, Berkeley); W (Naturhistorisches Museum, Wien); WEI (personal herbarium of W. E. Isaac); WU (Botanisches Institut der Universität Wien). All collections (or specimens) for which no herbarium abbreviation is given are housed at the University of California. Miss Pocock's and Professor Isaac's collections, except as otherwise indicated, are represented in their personal herbaria, whether or not duplicates have been deposited at Berkeley. The original set of the Ecological Survey collec-

tions is now housed in the Department of Botany, University of Cape Town. Duplicates from the 1937–1940 surveys have been deposited at Berkeley.

ACKNOWLEDGMENTS

I am indebted to the directors and curators of the herbaria listed above for their splendid co-operation in making historically and taxonomically important specimens available for study. My appreciation to Professor Papenfuss, Professor Isaac, and Dr. Pocock cannot be adequately expressed. Dr. Hannah Croasdale of Dartmouth College has kindly prepared the Latin diagnoses.

Key to Species of Codium in South Africa.

1. Thallus applanate, pulvinate, subglobose, or (if epiphytic) with orbicular foliose excrescences	2.
1. Thallus dichotomously branched, prostrate or erect ..	12.
2. Thallus applanate, pulvinate, or (if epiphytic) with orbicular foliose excrescences..	3.
2. Thallus subglobose	11.
3. Thallus saxicolous	4.
3. Thallus epiphytic (especially on *Cymodocea*)	10.
4. Apices of utricles acuminate	1. *C. acuminatum*
4. Apices of utricles rounded or truncate, not acuminate	5.
5. Thallus membraniform, 1·5—3 mm. thick, loosely attached to substratum	9. *C. pelliculare*
5. Thallus felt-like, mostly thicker than 3 mm., firmly attached to substratum	6.
6. Utricles mostly less than 105 μ diam.	7.
6. Utricles mostly greater than 105 μ diam.	8.
7. Thallus with well developed more or less free lobes; utricles markedly ninepin shaped	4. *C. stephensiae.*
7. Thallus with free edges, but without free lobes; utricles not markedly ninepin shaped	3. *C. lucasii* subsp. *capense.*
8. Thallus pulvinate; utricles mostly longer than 1·8 mm.	6. *C. spongiosum.*
8. Thallus applanate or convoluted; utricles mostly or entirely shorter than 1·8 mm.	9.
9. Thallus applanate; utricles mostly longer than 1 mm.	5. *C. incognitum.*
9. Thallus convoluted; utricles mostly shorter than 1 mm.	2. *C. mozambiquense.*
10. Thallus relatively firm; utricles mostly less than 105 μ diam.	3. *C. lucasii* subsp. *capense.*
10. Thallus very soft; utricles mostly greater than 105 μ diam.	2. *C. mozambiquense.*
11. Utricles in small clusters, mostly 330—520 μ diam. at apex	7. *C. papenfussii.*
11. Utricles mostly single, mostly 1·5—2·7 mm. diam. ..	8. *C. megalophysum.*
12. Thallus repent (rarely erect), branches intricate and anastomosing	11. *C. prostratum.*
12. Thallus erect, branches not anastomosing	13.
13. Thallus foliaceous	10. *C. platylobium.*
13. Thallus terete or complanate, not foliaceous	14.

14. Apices of utricles mucronate .. .. .. 19. *C. fragile* subsp. *capense*.
14. Apices of utricles not mucronate .. .. .. 15.
15. Utricles often longer than 1 mm. .. .. .. 17. *C. duthieae*.
15. Utricles rarely as long as 1 mm. .. .. .. 16.
16. Utricles often capitate (milk-bottle shaped), apices externally foveolate .. .. 12. *C. capitatum*.
16. Utricles not capitate, apices not externally foveolate 17.
17. Utricles very slender, clavate, with markedly and usually asymmetrically thickened apices .. .. 13. *C. pocockiae*.
17. Utricles stout, cylindrical to turbinate, apices not asymmetrically thickened.. .. .. 18.
18. Utricles cylindrical to slightly clavate, mostly 125—280 μ diam. .. .. 16. *C. extricatum*.
18. Utricles sometimes cylindrical, but more often markedly clavate, pyriform, or turbinate, commonly 200—400 μ diam. .. .. 19.
19. Distal parts of thallus tenuous; hair scars not abundant, usually one per utricle .. .. 14. *C. tenue*.
19. Distal parts of thallus not tenuous; hair scars either absent or abundant .. .. 20.
20. Hair scars abundant, usually several to many per utricle; apices subtruncate .. .. 15. *C. cicatrix*.
20. Hair scars absent; apices rounded .. .. .. 18. *C. isaacii*.

1. **Codium acuminatum** O. C. Schmidt, Bibl. Bot. 23 (91): 31, fig. 12 (1923). Pocock 1958, p. 25. [Fig. 1]

Thallus applanate, irregular in outline, closely adherent to substratum, very soft, 5—8 mm. thick. Utricles in large compound clusters, usually cylindrical, rarely slightly clavate (40—) 70—150 (—165) μ diam., (455—) 540—950 μ long (measured from apex to point of origin on parent utricle), size proportional to order of branching; primary utricles 155—225 μ diam., to 1·3 mm. long; utricles of final order of branching often not developing medullary filaments; apices moderately to very sharply pointed; utricular wall about 1·5 μ thick, at apex thickened to as much as 7·5 μ, prolonged into mucro in sharply pointed utricles; mucro often scalariform (chambered), to 50 μ long. Hairs (or hair scars) common on older utricles, to 10 per utricle, borne at broadest part of utricle (125—220 μ below apex). Medullary filaments mostly 21—35 μ diam. Gametangia lance-ovoid, ellipsoidal, fusiform, or oblance-ovoid, 47—82 μ diam., 165—270 μ long, 1 (—2) per utricle, each borne on short pedicel (5—8 μ long) below middle of utricle (410—525 μ below apex).

Type.—Tamatave, Madagascar, 1904, *Voeltzkow*. The holotype in the Botanisches Museum, Berlin, was destroyed by fire on March 1, 1943. Fortunately, a fragment of the holotype had previously been sent to Setchell by Schmidt and is now in the Herbarium of the University of California.

Other Collection Examined.—MOZAMBIQUE. Cabo Inhaca, on tufts of small corallines (*Jania* and *Amphiroa*) on floor of large pool in low

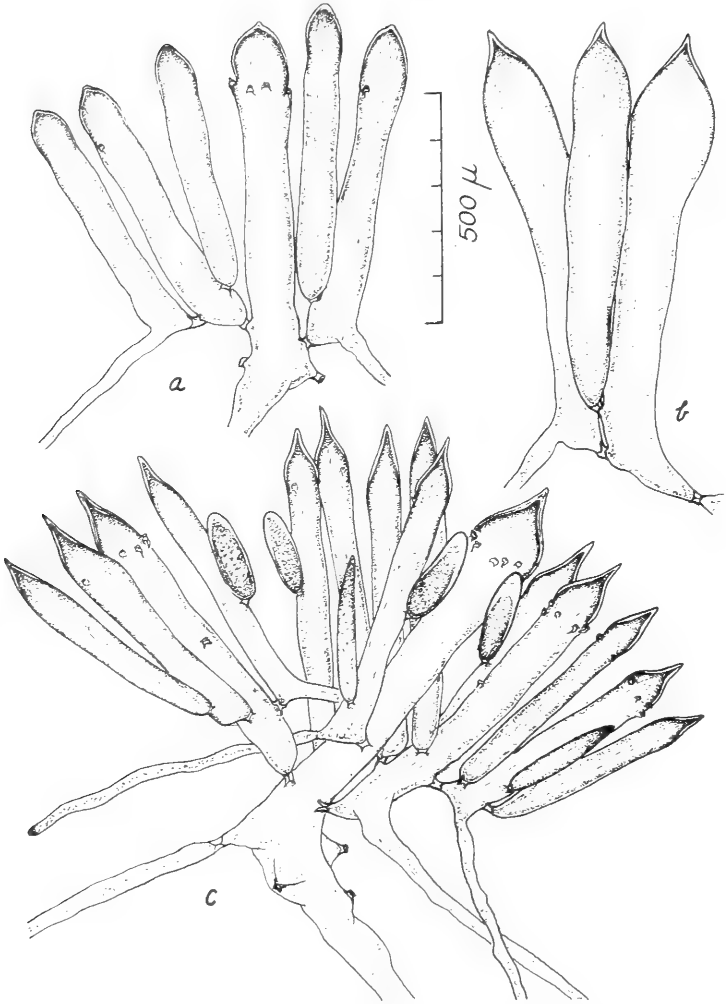

FIG. 1.—*C. acuminatum.* *a* (Tamatave, Madagascar, *Voeltzkow*=type), mature group of utricles from centre of thallus; *b*, *c* (Cabo Inhaca, Mozambique, *Pocock 12290*): *b*, mature group of utricles from edge of thallus; *c*, mature group of utricles from centre of thallus.

tide terrace, in company with *C. mozambiquense*, *C. lucasii* subsp. *capense*, *C. prostratum*, and *C. pocockiae*, rare, 26.ix.1957, *Pocock 12290*.

The rediscovery of this highly distinctive species, previously known only from the type collection, underscores the remarkable collecting skill of Miss Pocock. The Cabo Inhaca material is especially important because it is fertile, the type collection being sterile. The apices of utricles of the Cabo Inhaca plants are sharply pointed in contrast to the bluntly pointed utricles of the type specimen. This range of variation is to be expected, however, and undoubtedly results from environmental and age differences as well as from genic differences.

Schmidt indicated a close relationship between *C. acuminatum* and *C. arabicum* Kuetzing, a belief with which I am in full accord. It is probably still more closely related to *C. mozambiquense.* Growing in association with other adherent *Codium*, it resembles *C. mozambiquense*, and thereby differs from *C. lucasii* subsp. *capense*, in its very soft texture.

2. **Codium mozambiquense** sp. nov. [Fig. 2, Plate II, *a*]

Previous Record.—Pocock 1958, p. 25, as *Codium* sp.

Thallus conduplicatus, substratum (stipites *Cymodoceae*, particulas corallini defuncti) implicans, convolutus, mollis, excrescentias orbiculares foliosas ad 6 cm. lat. habens. Utriculi multum fastigiati, (90—) 100—190 (—275) μ diam., 510—1,050 μ long. (an apice ad locum originis in utriculo parenti metati), magnitudine ad ordinem ramificationis pro portione;

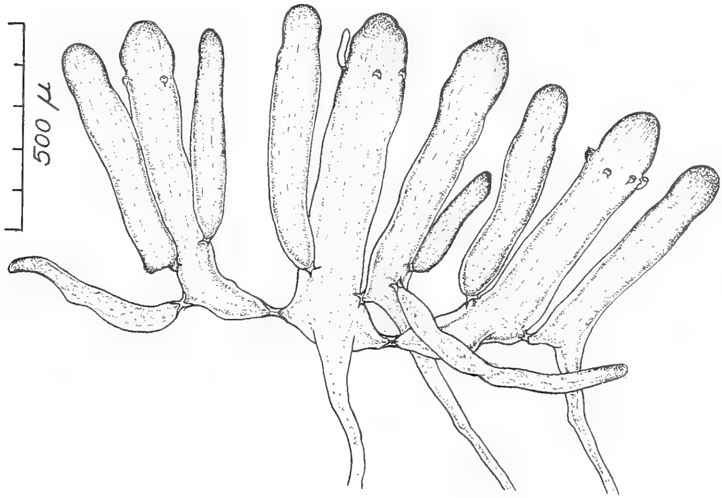

FIG. 2.—*C. mozambiquense* (Ponta Rasa, Mozambique, *Pocock 12268*=type). Mature group of utricles from centre of thallus.

utriculi primarii 190—275 μ diam., ad 1·5 mm. long.; utriculi ultimi ordinis ramificationis filamenta medullaria saepe non evolventes; utriculi cylindrici ad paulum clavatos, in regione 100—130 μ infra apicem (admodum super zonam cicatricum pilorum) aliquantulum constricti; cacumina apicum rotundata, lateribus saepe complanatis depressisve; membrana utriculari 1·5—2 μ crassa, ad apicem vix incrassata (—3 μ). Pili (aut pilorum cicatrices) in utriculis vetustioribus unus ad aliquot (—9) per utriculum, in zonà 135—185 μ infra apicem portati. Filamenta medullaria plerumque 27—41 μ diam. Gametangia non observata.

Thallus convoluted to conduplicate, adherent to flat coral slabs or enfolding stems of *Cymodocea* or pieces of dead coral, developing orbicular foliose isobilateral excrescences to 6 cm. broad, very soft. Utricles in large clusters, (90—) 100—190 (—275) μ diam., 510—1,050 μ long (measured from apex to point of origin on parent utricle), size proportional to order of branching; primary utricles 190—275 μ diam., to 1·5 mm. long; utricles of final order of branching often not developing medullary filaments; utricles cylindrical to slightly clavate, slightly constricted in region 100—130 μ below apex (just above hair scar zone); tips of apices rounded, with sides often flattened or depressed; utricular wall 1·5—2 μ thick, only slightly thickened at apex (—3 μ). Hairs (or hair scars) common on older utricles, one to several (—9) per utricle, borne in zone 135—185 μ below apex. Medullary filaments mostly 27—41 μ diam. Gametangia not observed.

Type.—Sandbank covered with coral debris off Ponta Rasa, Inhaca Channel, Mozambique, on *Cymodocea ciliata*, 25.ix.1957, leg. W. Macnae, comm. *Pocock 12268* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Other Collections Examined.—MOZAMBIQUE. Barreira Vermelha, on flat coral slabs near reef, 25.ix.1957, *Pocock 12260* (MAP). Cabo Inhaca, [on tufts of small corallines?] on floor of large pool in low tide terrace, in company with *C. acuminatum*, *C. lucasii* subsp. *capense*, *C. prostratum*, and *C. pocockiae*, 26.ix.1957, *Pocock 12283* (MAP). This species grows abundantly on *Cymodocea* and dead coral in Inhaca Channel. It is obviously closely related to *C. arabicum*, originally described from the Red Sea, from which it differs in having larger and stouter utricles with thin-walled apices of a characteristic shape: tips rounded, but often with the sides flattened or even depressed. The tendency toward asymmetrically flattened or depressed and slightly thickened apices (commonly to 6 μ, less often to 10 μ thick), exhibited by the type specimens of both *C. arabicum* and *C. coronatum* (cf. Silva 1952, fig. 11), is not present in *C. mozambiquense*. Previously (Silva 1952, p. 382) I have discussed the *C. arabicum* complex and described the spectrum of variation exhibited by specimens studied up to that time. Regarding

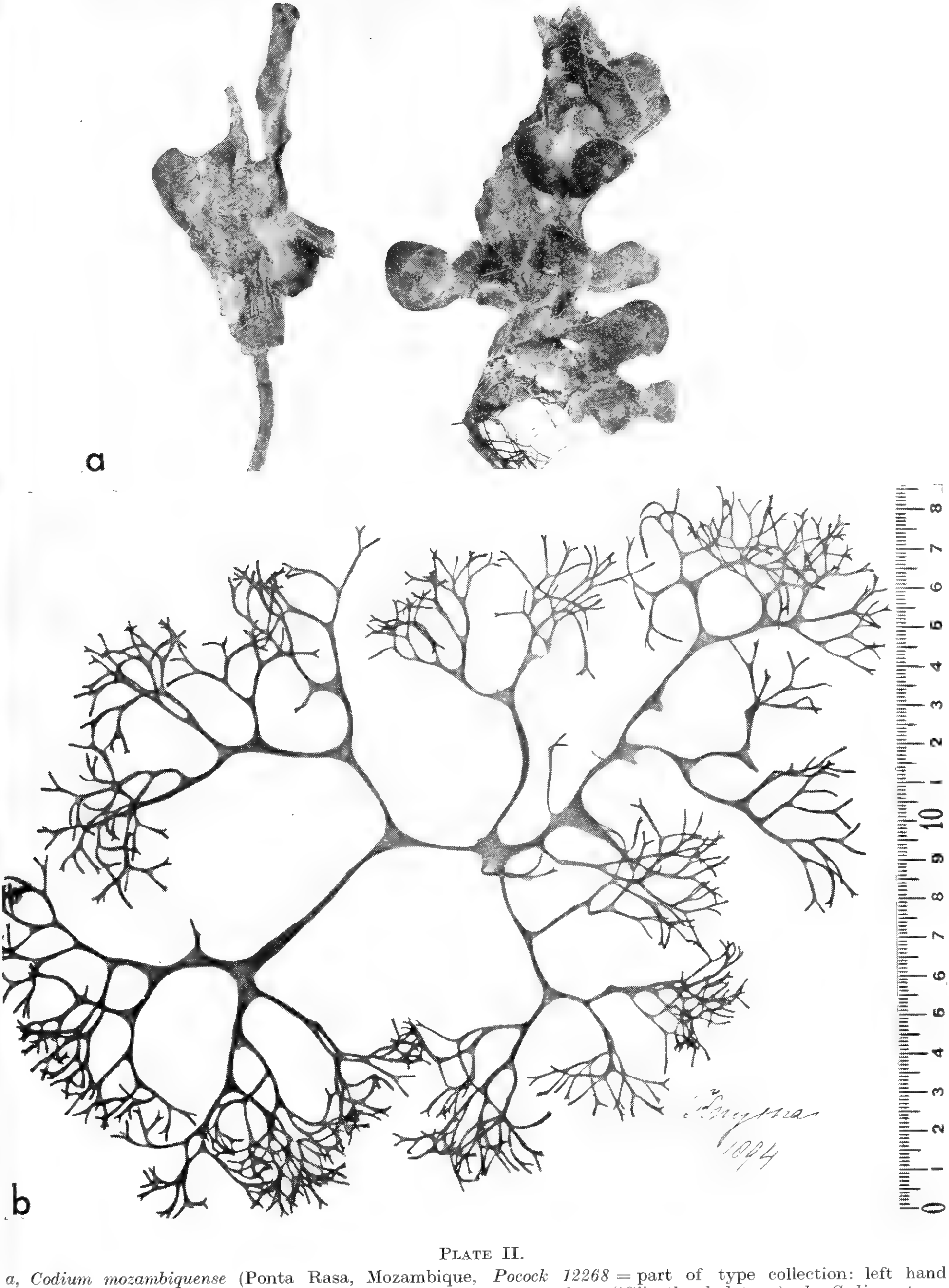

PLATE II.

a, *Codium mozambiquense* (Ponta Rasa, Mozambique, *Pocock 12268* = part of type collection: left hand specimen = plant "C", an isotype; right hand specimen = plant "G", the holotype); *b*, *Codium tenue* (Knysna, C.P., *A. Weber-van Bosse*, L).

the present material, my first inclination was to consider it as representative of a distinctive subspecies of *C. arabicum.* The decision to propose a new species rests on the belief that this treatment may facilitate an analysis of the complex, with the realization, however, that future study of material from the East African coast between Lourenço Marques and the Red Sea may lessen the individuality of the present material.

3. **Codium lucasii** Setchell subsp. **capense** subsp. nov. [Fig. 3]

Previous South African Records.—Barton 1896, p. 194, as *C. adhaerens*, Knysna (*Newdigate*) record only, pro parte (identity inferred from description). Schmidt 1923, p. 27, as *C. adhaerens*, "Kaffernküste" record only (identity inferred from description and locality). Eyre, Broekhuysen,

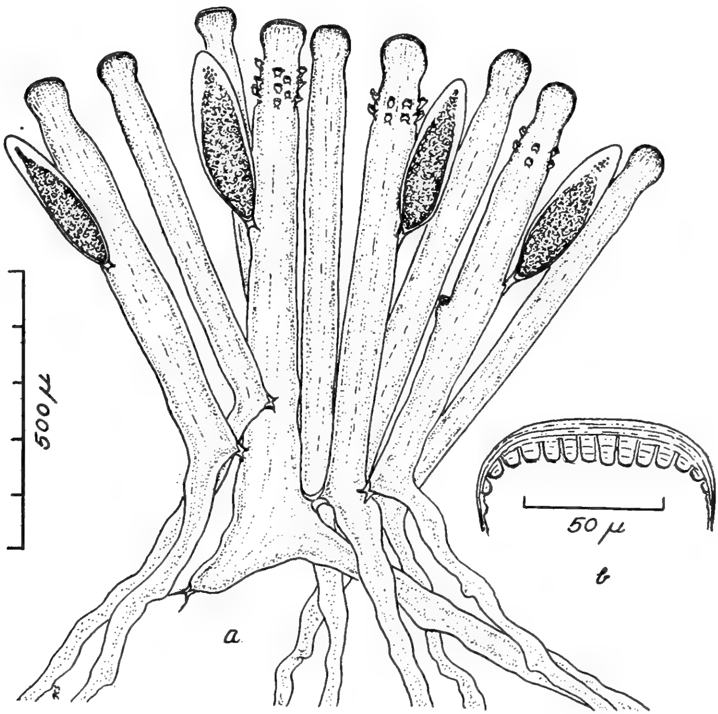

FIG. 3.—*C. lucasii* subsp. *capense*. *a* (Umpangazi, Natal, *Ecol. Surv. G.2.B*), mature group of utricles from centre of thallus; *b* (Storms River, C.P., *Ecol. Surv. T.T.7.A*), apex of utricle showing details of wall thickening.

and Crichton 1938, p. 91, as *C. stephensiae* (*Ecol. Surv. L.15*). Stephenson 1944, pp. 314, 317, and 349, as *C. lucasii* (*Ecol. Surv. AR.1.D*; etc.). Stephenson 1947, pp. 284 and 296, as *C. lucasii*. Silva 1951, p. 92, fig. 15, as *Codium sp.* Pocock 1958, p. 25, as *C. arabicum* and *C. lucasii*.

Thallus applanatus solidus lubricus atroviridis, 2·5—5 mm. crass., primum orbicularis, mox lobos, marginibus non affixis, substrato arcte plane adhaerentes evolvens. (Thalli epiphytici conduplicati excrescentiis orbicularibus foliosis substratum implicantes.) Utriculi multum fastigiati (50—) 60—105 (—125) μ diam., (435—) 500—800 (—1,100) μ long. (ab apice ad locum originis in utriculo parenti metati), magnitudine ad ordinem ramificationis pro portione, cylindrici, 50—80 μ infra apicem mediocre ad valde constricti; apices truncati, depressi aut rotundati, quasi symmetrici; membrana utricularis tenuis (1·5 μ), ad apices plerumque vix aut paululum (3—12 μ), raro modice (—35 μ) incrassata, interne saepe non profunde alveolata ad profunde cribrosa; pili (aut pilorum cicatrices) in utriculis vetustioribus frequentes, in taeniam 70—145 μ infra utriculi apicem extendens portati, saepe ordines verticales formantes. Filamenta medullaria (15—) 20—35 μ diam. Gametangia lanceo-ovata, fusiformia ad oblanceo-ovata (48—) 60—125 μ diam., 215—370 μ long., unum per utriculum (duo in utriculis vetustioribus maioribusque) in pediculo distincto 280—405 μ infra apicem utriculi plerumque portata.

Thallus applanate, firm, slippery, very dark green, 2·5—5 mm. thick, at first orbicular, soon developing lobes which form a close flat pattern tightly adherent to substratum but with free margins. (Epiphytic thalli conduplicate, enfolding substratum, with orbicular foliose excrescences.) Utricles in large clusters, (50—) 60—105 (—125) μ diam., (435—) 500—800 (—1,100) μ long (measured from apex to point of origin on parent utricle), size proportional to order of branching, cylindrical, slightly to markedly constricted 50—80 μ below apex; apices truncate, depressed, or rounded, approximately symmetrical; utricular wall thin (1·5 μ), at apices usually very slightly or slightly thickened (3—12 μ), seldom moderately thickened (—35 μ), internally often shallowly alveolate to deeply cribrose; hairs (or hair scars) common on older utricles, borne in band extending 70—145 μ below apex of utricle, often forming vertical rows. Medullary filaments (15—) 20—35 μ diam. Gametangia lance-ovoid, fusiform, to oblance-ovoid, (48—) 60—125 μ diam., 215—370 μ long, usually borne one per utricle (two on older and larger utricles) on distinct pedicel 280—405 μ below apex of utricle.

Type.—Chaka's Rock (near Umhlali), Natal, 12.vii.1938, *Pocock & Papenfuss 1058* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Known Range.—Somerset Strand, False Bay (drift ?); Struis Bay Beach, Cape Province, to Cabo Inhaca, Mozambique.

Representative Collections Examined.—CAPE PROVINCE. Somerset Strand, drift ?, 2.xii.1937, *Papenfuss s.n.* Struis Bay Beach, cast ashore, 1.iii.1937, *Papenfuss 335.* Arniston, 23.xi.1939, *Ecol. Surv. AR.1.D.* Cape Infanta, 8.xii.1939, *Ecol. Surv. CI.1.E.* Still Bay, 10.xi.1939, *Ecol. Surv. SSS.1.G.* Groot River Mouth, ii.1941, *Rhodes Univ. Coll. Exped.* (RU). Knysna, 26.ix.1958, *Isaac B.693* (WEI). Storms River Mouth, 25.i.1940, *Ecol. Surv. TT.7.A.* Port Elizabeth, 1894, *Weber-van Bosse* (L, NY). Bushman's River Mouth, vii.1937, *Duthie 8388.* Kasouga (Ship Rock), 1.iii.1953, *Pocock 10589.* Sharks Bay, 21.ix.1952, *Pocock 10507.* Port Alfred, 1.vii.1938, *Pocock & Papenfuss 1052.* Riet River Mouth, 2.x.1943, *Pocock 7719.* Cove Rock, 18.vii.1943, *Pocock 7360.* East London (Shelly Beach), 6.vii.1937, *Ecol. Surv. L.15.* Qolora, 4.x.1952, *Pocock 10560.* Qora River Mouth, 3.viii.1938, *Pocock & Papenfuss 1044.* Dwessa, 16.i.1953, *Isaac I.1158.* Port St. Johns, 28.vii. 1938, *Pocock & Papenfuss 1048.* NATAL. Port Edward, 16.v.1939, *Ecol. Surv. WW.1K.* Port Shepstone, 27.vii.1938, *Pocock & Papenfuss 1047.* Hibberdene, 30.x.1951, *Pocock 9985.* Isipingo, 18.vii.1938, *Pocock & Papenfuss 1255* (UC only). Reunion Rocks, 29.x.1951, *Pocock 9943.* Durban (The Bluff), 15.vii.1938, *Pocock & Papenfuss 1051.* Umhloti Beach, 9.vii.1938, *Pocock & Papenfuss 1256.* Umpangazi, 2.v.1939, *Ecol. Surv. G.2.B.* Kosi Bay, 25.v.1948, *Rodin 4631.* MOZAMBIQUE. Cabo Inhaca, on floor of large pool in low tide terrace, 26.ix.1957, *Pocock 12289* (MAP). Sandbank covered with coral debris off Ponta Rasa, on *Cymodocea* and dead coral, 25.ix.1957, leg. W. Macnae, comm. *Pocock 12276.* Barreira Vermelha, on flat coral slabs near reef, 13.xii.1955, *Pocock 11089* (MAP).

The slightly larger diameter of utricles of *Codium lucasii* as represented in South Africa enables a South African specimen to be distinguished from an Australian specimen in a majority of instances. There is an overlap in the range of variation of the two subspecies, however, and certain South African plants (e.g., *Rodin 4631* from Kosi Bay) have utricles of an average diameter smaller than certain Australian plants (e.g., *Womersley A20,401* from Elliston).

From Arniston to Umpangazi, *C. lucasii* exhibits relatively little morphological variability. In the Inhaca region, however, considerable variability is displayed, both in habit (as related to habitat) and in anatomy. While *C. lucasii* is always saxicolous in the Union, in the Inhaca region it often grows on *Cymodocea* and corallines. Epiphytic thalli develop orbicular foliose isobilateral excrescences and thus resemble *C. mozambiquense* and other members of the *C. arabicum* complex. Anatomically, some plants, both saxicolous and epiphytic, closely resemble plants from the Union, while other plants have stouter utricles with apices less markedly or not at all cribrose, features suggestive of *C.*

mozambiquense. These plants, however, clearly seem more closely related to *C. lucasii* subsp. *capense* than to *C. mozambiquense* or to any other facet of the *C. arabicum* complex known to me. Further speculation as to their taxonomic disposition must await more detailed studies.

The earliest South African collection of this species apparently is one made by Mme. Weber-van Bosse in 1894 at Port Elizabeth and identified by her as *C. adhaerens.* Subsequently, Barton (1896) reported under the name *C. adhaerens* a collection from Knysna which, to judge from her description, was a mixture of *C. lucasii* and *C. stephensiae.* (I have not been able to locate this collection, which Barton indicated as liquid-preserved.) Barton's record was discussed by Dickinson (1932, p. 135) in connection with her account of *C. stephensiae.* Despite Miss Dickinson's statement that "it is practically certain that the entirely adhaerent specimens referred to by Miss Barton differ specifically [from *C. stephensiae*]," the presence of an entirely (or almost entirely) adherent *Codium* in South Africa was forgotten until Dr. Papenfuss, in connection with the Ecological Survey, pointed out differences in habit and habitat between *C. stephensiae* and the plants which he referred to *C. lucasii.* The thallus of *C. stephensiae* develops large lobes which are isobilateral (i.e., with cortex on both surfaces), prostrate, and mostly or entirely free from the substratum. The lobes of *C. lucasii* are small, dorsiventral (i.e., with cortex only on the upper surface), and firmly adherent to the substratum everywhere except at the margins. *C. stephensiae* usually grows in pools in the lower littoral zone of sheltered situations. *C. lucasii,* on the other hand, over most of its range forms a broad zone at mid-tide level which extends across fully exposed as well as partially protected areas. (At Inhaca it appears to be submerged even at low tide, whether it is epiphytic or saxicolous.) In earlier work of the Ecological Survey the two species were confused; in more recent work they have been properly separated. Setchell (in manuscript) considered the entirely adherent South African *Codium* distinct from *C. lucasii,* but his concept was based on a mixture of *C. lucasii* and *C. pelliculare.*

C. lucasii is readily distinguishable from *C. stephensiae* anatomically. The thallus dissects out into irregularly sized clusters of utricles without particularly conspicuous primary utricles. The utricles are characteristically capitulate, and the apices are often internally shallowly alveolate to deeply cribrose. In *C. stephensiae,* by contrast, the thallus dissects out into large clusters of utricles, each cluster comprising a conspicuously large primary utricle surrounded by derivative utricles whose size is proportional to the order of branching. The utricles are characteristically constricted below the apex for a distance of about 100 μ, giving a pro-

nounced ninepin appearance. The apices are usually moderately thickened and broadly introrsely umbonate, but rarely alveolate or cribrose.

4. **Codium stephensiae** Dickinson, Rev. Alg. 6: 131, pl. 3, text—figs. 1—3 (1932). Isaac 1937*b*, p. 130. Stephenson, Stephenson, and Du Toit 1937, pp. 356, 367, and 372. Stephenson, Stephenson, and Bright 1938, p. 6. Eyre 1939, p. 296. Pocock 1939, p. 78. Stephenson 1944, pp. 314, 317, 336, and 350. Stephenson 1947, pp. 284 and 296. Isaac 1949, pp. 132, 140, 150, 155, 156, 157, and 158. [Fig. 4, Plates III and IV]

Records Under Incorrect Determinations.—Barton 1893, p. 82, as *C. laminarioides* (Cape Point, *Boodle*, BM). Barton 1896, p. 194, as *C. adhaerens*, Knysna (*Newdigate*), pro parte (identity inferred from description); Port Elizabeth (*Farquhar 7*, 1893, BM). Delf 1921, p. 58,

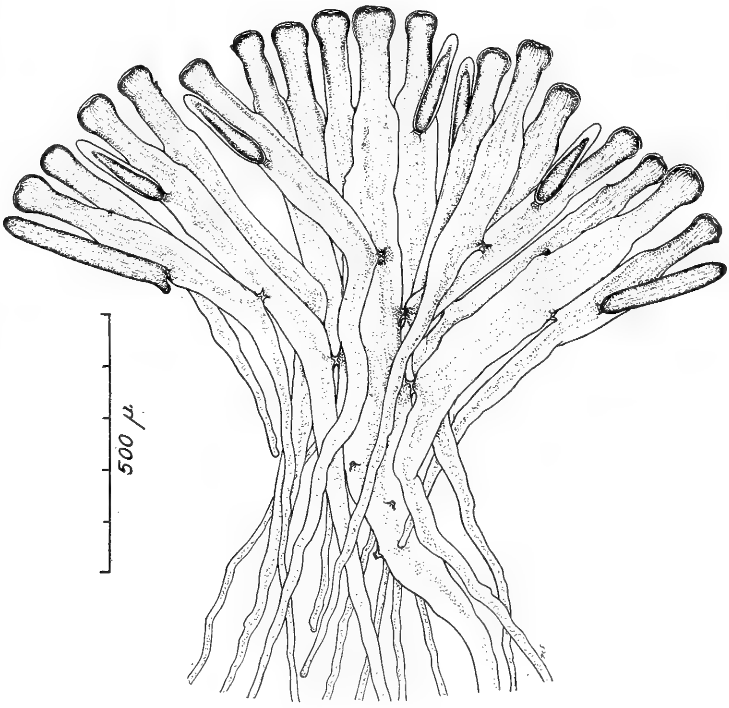

FIG. 4.—*C. stephensiae* (Storms River, C.P., *Ecol. Surv. T.2.C*). Mature group of utricles from centre of thallus.

as *C. lindenbergii* (identity inferred from locality). Delf and Michell 1921, p. 95, as *C. lindenbergii,* False Bay record only (Gordons Bay, *W. Tyson*, BOL).

Excluded Record.—Eyre, Broekhuysen, and Crichton 1938, p. 91= *C. lucasii* subsp. *capense* (*Ecol. Surv. L.15*).

Thallus applanate, procumbent, velvety but tough, dark green, 2·5—4 mm. thick, adherent to substratum in central portion and here and there in otherwise free lobes by patches of rhizoidal attachments; lobes crenate when young, becoming irregularly or subdichotomously cleft, isobilateral, in large part free from substratum, anastomosing one with another, to 30 cm. long. Utricles of dorsal surface in large clusters, varying in length from 315 μ (ultimate order of branching) to 1·5 mm. (first order of branching), mostly 55—110 (—125) μ diam. at apex, cylindrical, with slightly rounded to truncate or depressed apices, usually constricted below apex for distance of 80—115 μ, giving a ninepin effect, expanding to maximum diameter below constriction; utricular wall 1·5—3 μ thick, at apices moderately thickened (—30 μ) and lamellate, slightly to markedly broadly introrsely umbonate with a tendency to be extrorsely umbonate as well. Utricles of ventral surface similar to those of dorsal surface, but usually stouter and less characteristically constricted. Hairs (or hair scars) scarce, 1 (—3) per utricle, borne 35—50μ below apex. Medullary filaments mostly 19—52 μ diam., one arising from base of each utricle by stout outgrowth so that utricle and filament intergrade. Gametangia cylindrical, 45—75 μ diam., 200—325 μ long, one (seldom two) per utricle, borne on short pedicel 300—460 μ below apex of utricle.

Type.—Not designated, but inasmuch as the original description was "largely based on material collected by Mr. G. Taylor of the British Museum and preserved in formalin" (Dickinson 1932, p. 135), the Taylor specimen from Kommetje, a photograph of which was published as pl. 3, fig. A, and which is now dried and conserved in the herbarium at Kew, is hereby selected as lectotype.

Known Range.—Cape Province: Langebaan to Dwessa.

Representative Collections Examined.—CAPE PROVINCE. Langebaan, 3.iii.1938, *Papenfuss 331.* Melkbosch, 5.ii.1939, *Papenfuss 382.* Kommetje, 1927, *G. Taylor* (K). Olifantsbosch, 4.iv.1954, *Isaac I.462.* Cape Maclear, 10.i.1947, *Pocock 8992.* False Bay: Kalk Bay, 20.vii.1936, *Papenfuss 333*; Strandfontein, xii.1932, *E. L. Stephens*; Somerset Strand, 23.iv.1935, *A. V. Duthie*; Gordons Bay, *W. Tyson* (BOL); Steenbras River Mouth, 21.iii.1936, *G. van Wyk*; Cape Hangklip, 8.i.1940, *Ecol. Surv. C.H.1.B.*; *CH.4.A.* Hermanus, 2.vii.1939, *Ecol. Surv. HM.5.A.* Danger Point, 27.xi.1939, *Ecol. Surv. D.D.P.1.B.* Cape Agulhas, 22.ii.1939, *Pocock 497.*

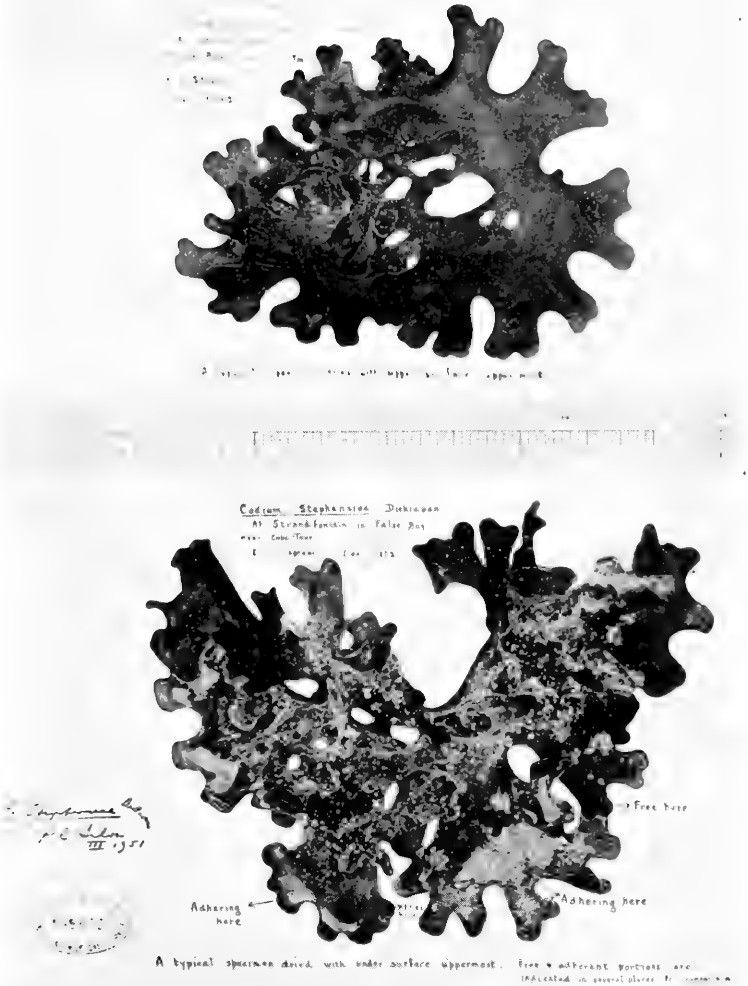

Plate III. *Codium stephensiae.*
(Strandfontein, False Bay, C.P., *E. L. Stephens.*)

PLATE IV. *Codium stephensiae.*
(Langebaan, C.P., *Papenfuss 331*). An unusually large plant.

Arniston, 20.ii.1939, *Pocock 524A*. Groot River Mouth, ii.1941, *Rhodes Univ. Coll. Exped.* (RU). Storms River Mouth, 2.iv.1939, *Ecol. Surv. T.2.C*; 24.i.1940, *Ecol. Surv. TT.2.A*. Humewood, 1.i.1937, *W.J.G. Styn.* Port Elizabeth, 13.ii.1952, *Isaac B.465.* Port Alfred, 21.i.1939, *Ecol. Surv. K.3.B.* Riet River Mouth, 2.x.1943, *Pocock 7718.* Kleinmond, 19.iii.1939, *Ecol. Surv. X.1.U.* Kidd's Beach, 2.v.1957, *Isaac B.516* (WEI). East London, 20.vi.1948, *Rodin 4778.* Morgan Bay, 2.vii.1943, *Pocock 7065.* Qolora, 20.v.1939, *Ecol. Surv. QQ.1.A*. Dwessa, 14.i.1953, *Isaac B.466*.

The earliest collection of *C. stephensiae* of which I am aware is one made by Burmann (PC) and designated by Lamouroux on the herbarium label as a new species (which was never published). The earliest record of *C. stephensiae* is the report by Barton (1893) under the name *C. laminarioides* of a specimen collected at Cape Point by Boodle. Subsequently, collections of *C. stephensiae* intermixed with *C. lucasii* subsp. *capense* from Knysna and Port Elizabeth were reported by Barton (1896) under the name *C. adhaerens*. Barton's statement, "The specimens of this alga, which have been sent by Miss Newdigate, preserved in spirit, are only attached to the substratum at the centre of the thallus, and the rest of the flat frond is free, though prostrate," constitutes the first recognizable reference to *C. stephensiae*. Barton continued: "It was suggested to me that this was a new species of *Codium*, but since in the same sending I find plants in which the thallus entirely adheres to the substratum [*C. lucasii*], I believe that all the specimens are but forms of *C. adhaerens*."

In its development of isobilateral lobes, *C. stephensiae* is set apart from all other adherent *Codium* except its close relative, *C. coarctatum* Okamura from Japan, which differs in its narrow, markedly subdichotomously cleft lobes and in certain details of its utricles. The lobes are isobilateral only in the sense that there is a ventral as well as a dorsal cortex of utricles. The ventral cortex is not as tightly packed as the dorsal cortex, however, and the utricles exhibit many differences: they contain less chlorophyll, they are stouter, their constriction is less uniformly characteristic, and they are intermixed with many single (unbranched) utricles. However, Miss Dickinson's statement that "as a rule the individual utricles are produced singly at the ends of the medullary filaments, but branching occurs to some extent" is not borne out by my observations. Toward the centre of the thallus the ventral utricles may be large, clavate, and thin-walled, of the type shown in fig. 2 of Miss Dickinson's paper. This type of utricle is common in all adherent *Codium* occurring near and on the margins, intermixed with "normal" (i.e., characteristic) utricles, and intermittently among the mass of rhizoids on the lower surface of the thallus.

C. stephensiae usually grows in pools in the lower littoral zone. According to Isaac (1949, p. 140), in the Rooi Els–Gansbaai region it "occurs typically in sheltered situations on vertical rock faces, and it seems to be favoured by the proximity of brackish water." Most localities where *C. stephensiae* grows luxuriantly, however, are not influenced by brackish water. According to Miss Pocock (in lit.), at Papenkuil Fontein near Cape Agulhas it carpeted a small rocky bay (8.ii.1940, *Pocock* 2850).

5. **Codium incognitum** sp. nov. [Fig. 5]

Thallus applanatus mollis ad 5 mm. crass., substrato per superficiam latam adhaerens. Utriculi fastigiati 100—165 (—260) μ diam., 720 μ—2·4 mm. long. (ab apice ad locum originis in utriculo parenti metati), magnitudine ad ordinem ramificationis pro portione, cylindrici, 575—850 μ infra apicem plerumque inflati; apices truncati aut paululum rotundati; membrana utricularis 1·5 μ crass., ad apices vix incrassata (—8 μ). Pili aut pilorum cicatrices non observati. Filamenta medullaria plerumque 25—55 μ diam., gametangia cylindrica ad paululum fusiformia, 55—75 μ diam., (210—) 260—340 (—390) μ long., 1—3 per utriculum, omnia in pediculis parvis (5—7 μ long.) 300—470 μ infra apicem portata.

Thallus applanate, soft, to 5 mm. thick, adherent to substratum over broad area. Utricles in clusters, 110—165 (—260) μ diam., 720 μ—2·4 mm. long (measured from apex to point of origin on parent utricle), size proportional to order of branching, cylindrical, frequently swollen 575—850 μ below apex; apices truncate or slightly rounded; utricular wall 1·5 μ thick, at apices only slightly thickened (—8 μ). Hairs or hair scars not observed. Medullary filaments mostly 25—55 μ diam. Gametangia cylindrical to slightly fusiform, 55—75 μ diam., (210—) 260—340 (—390) μ long, 1—3 per utricle, each borne on short pedicel (5—7 μ long) 300—470 μ below apex of utricle.

Type.—Robberg, Cape Province, 4.vi.1939, *Ecol. Surv. RR.1.F* (UC; isotype in CT).

While in general it is poor taxonomic practice to propose a new species on the basis of a single collection, the present material is so distinctive as to warrant its description. Only two fragments of plants are available, both male. The absence of hairs tentatively is significant. The closest relative in South Africa is *C. spongiosum.* A clear indication of the tidal zone which *C. incognitum* occupies is given by the fact that the thallus is attached to *Balanus* shells.

6. **Codium spongiosum** Harvey, Trans. Roy. Irish Acad. 22: 565 (1855). Stephenson 1947, p. 296, excl. Port Edward record. Pocock 1958, p. 25, as *Codium* sp. [Fig. 6]

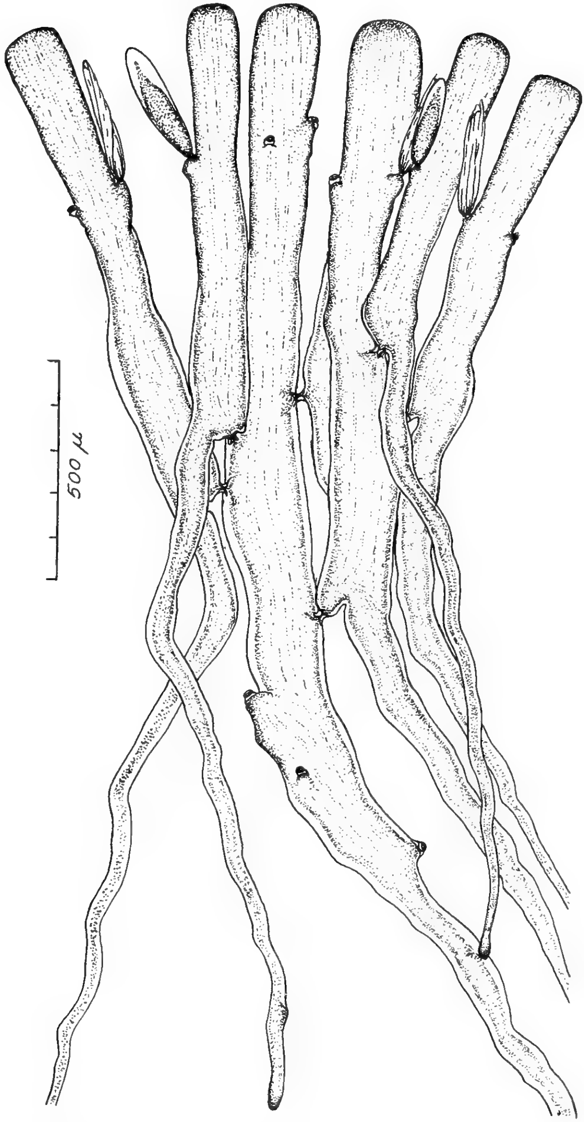

Fig. 5.—*C. incognitum* (Robberg, C.P., *Ecol. Surv. RR.1.F*=type). Mature group of utricles from centre of thallus.

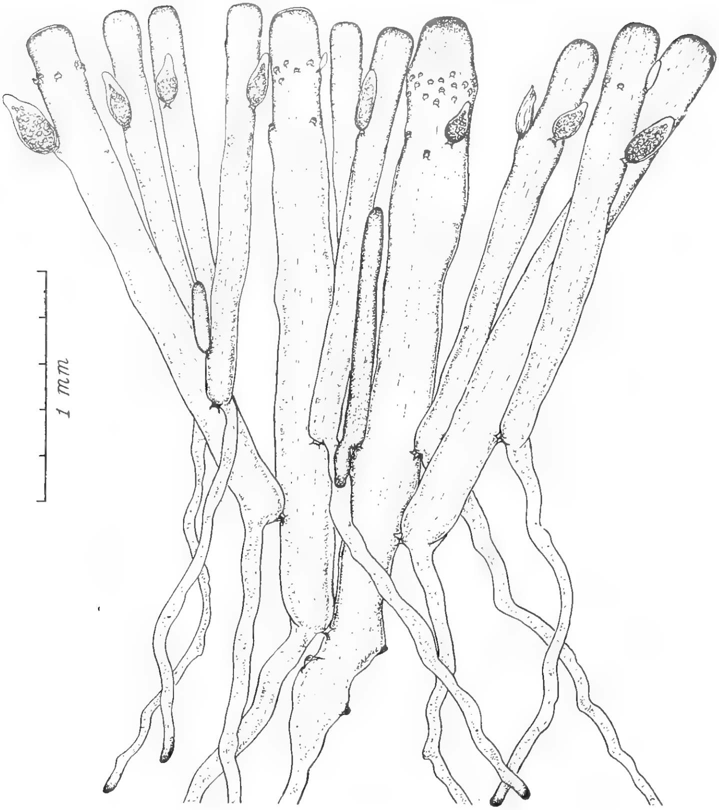

Fig. 6.—*C. spongiosum* (Durban, Natal, *Pocock & Papenfuss 372*). Mature group of utricles from centre of thallus.

Record Under Incorrect Determination.—Levring 1938, p. 16, as *C. mamillosum* (Isipingo, *Ecol. Surv. D. 23*, CT).

Excluded Records.—Schmidt 1923, p. 32=*C. bursa* (HBG, "C. b. sp." in error). Stephenson 1947, p. 296, Port Edward record only=*C. papenfussii* (*Ecol. Surv. WW.2.G*).

Thallus applanate or pulvinate, undulate to cerebriform, soft, becoming gelatinous in liquid preservative, nitidous when dried and pressed, to 2 cm. thick, 6—10 (—25) cm. diam., loosely adherent to substratum. Utricles in large clusters, those of final order of branching cylindrical or clavate, 130—300 (—390) μ diam., 1·4—2 mm. long, those of lower

orders of branching to 520 μ diam. at apex, gradually enlarging below up to 850 μ diam., 2·8—4 (—6) mm. long; apices subtruncate to rounded; utricular wall 2—3 μ thick, at apices very slightly to moderately thickened (—32 μ), incrassate apices finely lamellate and slightly introrsely umbonate. Hairs (or hair scars) abundant, forming band about 120—200 μ wide and 130—430 μ below apex of utricle. Medullary filaments mostly 30—100 μ diam. Gametangia lance-ovoid or ampulliform, 50—175 μ diam., 215—360 μ long, usually several per utricle, each borne on short pedicel 360—660 μ below apex of utricle.

Lectotype.—King George's Sound, Western Australia, *W. H. Harvey*, Algae Australicae Exsiccatae 577 (TCD).

Known Range.—Hibberdene, Natal, to Cabo Inhaca, Mozambique. Mauritius. Australia. Lord Howe Island. New Caledonia. Hawaiian Islands.

Representative South African Collections Examined.—NATAL. Hibberdene, 30.x.1951, *Pocock 9982.* Umtwalumi River Mouth, 25.xii.1938, *Ecol. Surv. M.1.A.* Isipingo Beach, xi.1894, *Weber-van Bosse* (L); 28.vi.1935, *Ecol. Surv. D.23* (CT). Reunion Rocks, 29.x.1951, *Pocock 9942.* Durban (The Bluff), 15.vii.1938, *Pocock & Papenfuss 372.* Umhlali Beach (Chaka's Rock), 23.xii.1938, *Ecol. Surv. U.21.A* (CT). Kosi Bay, 25.v.1948, *R. J. Rodin.* MOZAMBIQUE. Cabo Inhaca, cast ashore, 26.ix.1957, *Pocock 12292* (MAP).

The only record of *C. spongiosum* from South Africa other than Stephenson's (1947) is that by Schmidt (1923, p. 32), who cited only "Kap". Lucas (1935, p. 202) conjectured that "Kap" might refer to Cape York, and Børgesen (1946, p. 46) accepted this interpretation. Fortunately, I have located the specimen upon which the record is based in Herb. Hamburg. It bears the datum, "Cap. b. sp.," and is annotated *C. spongiosum* by Schmidt. This specimen is referable to *C. bursa*, and it is reasonable to conclude that it did not come from South Africa. Mme. Weber-van Bosse collected *C. spongiosum* at Isipingo in 1894 and determined it as *C. adhaerens*, but this was not recorded in literature.

Anatomically, the South African material is indistinguishable from plants from Western Australia, the type locality. South African plants exhibit some differences in habit and habitat, however: they apparently never attain the great size of Australian plants; and they are uncommon, growing in cracks in flat open bare rock or around the rims of small pools in the lower littoral zone, whereas in Australia this is a very abundant sublittoral species, extending to just below low tide level.

C. spongiosum is the only strictly Indo-Pacific element in the South African *Codium* flora.

7. **Codium papenfussii** sp. nov. [Fig. 7, Plate V]

Records Under Incorrect Determinations.—Delf and Michell 1921, p. 95, as *C. bursa*, Camps Bay record only (identity inferred from description and locality). Pocock 1939, pp. 76 and 78, as *C. bursa.* Stephenson 1947, p. 296, as *C. spongiosum*, Port Edward record only (*Ecol. Surv. WW.2.G*).

Thallus iuvenis hemisphericus ad subglobosum solidus, vetustior per attenuationem plexus filamentorum medullarium ad 7 (—12) mm. diam. applanatus cavusque, subtrato per penicillum hapterorum rhizoideorum laxe adhaerens, in latere inferiore depressus. Utriculi maturi parum fastigiati, cylindrici aut paululum clavati, gibberum prominentem 350—700 μ infra apicem proprie praebentes, (300—) 330—520 μ diam. in apice, ad 680 μ ad gibbum (2·4—) 3—4·6 (—5·4) mm. long.; apices truncati aut paululum rotundati; membrana utricularis 2·5—5 μ crassa ad apices aliquantulum incrassata (—12 μ). Pili absentes. Filamenta medullaria plerumque 50—110 μ diam., unum per excrescentiam crassam a basi utriculi omnis enascens. Gametangia lanceo-ovata, 155—220 μ diam., 480—590 μ long., in pediculis circa 15 μ long., uno vel duobus per utriculum, 920—1,050 μ infra utriculi apicem portata.

Thallus when young hemispherical to subglobose, firm, becoming flattened and hollow with age by attenuation of plexus of medullary filaments, to 7 (—12) cm. diam., loosely adherent to substratum by tuft of rhizoidal holdfasts, depressed on under side. Mature utricles in small clusters, cylindrical or slightly clavate, characteristically with a prominent bulge 350—700 μ below apex, (300—) 330—520 μ diam. at apex, to 680 μ diam. at bulge, (2·4—) 3—4·6 (—5·4) mm. long; apices truncate or slightly rounded; utricular wall 2·5—5 μ thick, at apices slightly thickened (—12 μ). Hairs absent. Medullary filaments mostly 50—110 μ diam., one arising from base of each utricle by stout outgrowth. Gametangia lance-ovoid, 155—220 μ diam., 480—590 μ long, borne on pedicel about 15 μ long, one or two per utricle, 920—1,050 μ below apex of utricle.

Type.—Kalk Bay (in False Bay), Cape Province, cast ashore, 14.xi.1936, *Papenfuss 327* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Known Range.—Camps Bay, Cape Province, to Port Edward, Natal.

Representative Collections Examined.—CAPE PROVINCE. Kommetje, viii.1927, *A. V. Duthie.* False Bay: Muizenberg, 30.xii.1945, *M. A. Pocock 8577*; Somerset Strand, 14.iv.1933, *E. Strauss*; Gordons Bay, *Duthie 8091.* Struis Bay Beach, 1.iii.1937, *Papenfuss 328.* Arniston, 13.xii.1942, *Pocock 6607.* Still Bay, iv.1937, *N. van der Merwe.* Port

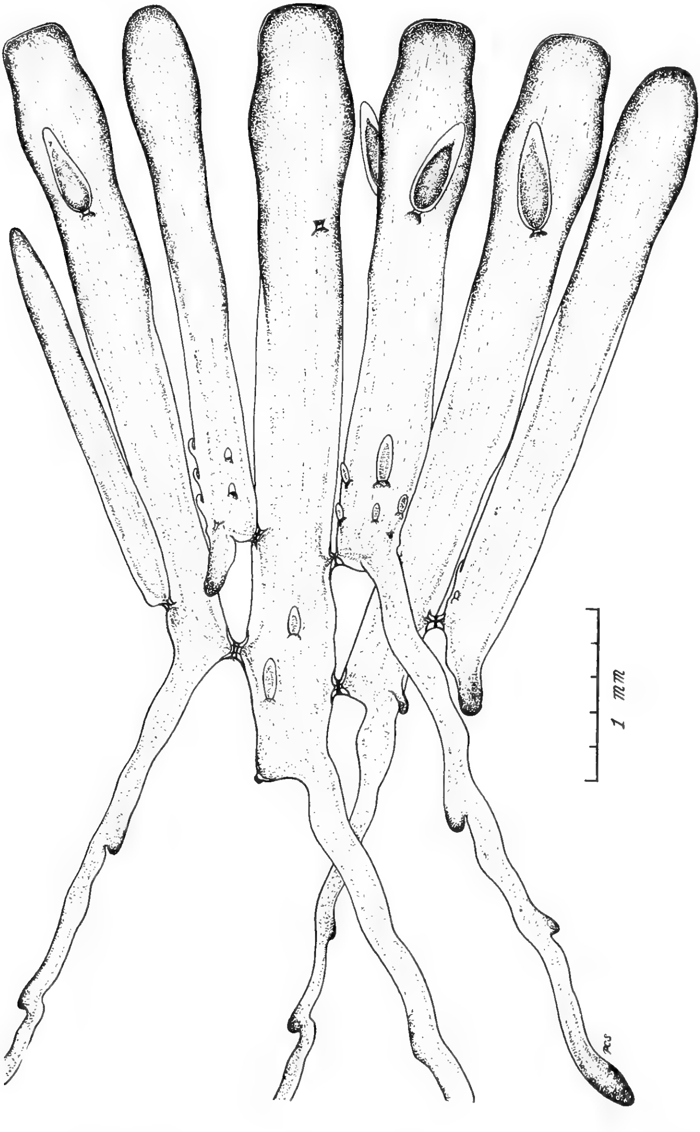

FIG. 7.—*C. papenfussii* (Port Edward, Natal, *Ecol. Surv. WW.2.G*). Mature group of utricles.

Elizabeth, 11.ii.1952, *Isaac B.480* (WEI). Quaai Hoek, Richmond, 13.ii.1944, *Pocock 8027.* Riet River Mouth (Three Sisters), 14.viii.1946, *Pocock 8775.* NATAL. Port Edward, 17.v.1939, *Ecol. Surv. WW.2.G.*

The earliest record of *C. papenfussii* is the report by Delf and Michell of "*C. Bursa* being washed up at Camps Bay after rough weather." Numerous dried specimens, mostly from False Bay, were sent by Dr. A. V. Duthie to Professor Setchell, who (in herbarium notes) considered them representative of a new species, but he confused this entity with *C. megalophysum.* Working with living or liquid-preserved material, one can easily distinguish among *C. papenfussii, C. megalophysum,* and *C. bursa. C. megalophysum* is distinguished from all other species by its huge utricles (1—3·9 mm. diam.), loosely grouped in a hemispherical or subglobose cluster. *C. bursa,* though not very different in habit from *C. papenfussii,* exhibits fundamental anatomical differences. In *C. bursa* the thallus dissects out mostly into individual utricles; occasional clusters of two or three utricles result from foreshortening and abortion of secondary sympodial systems. In *C. papenfussii* the thallus dissects out into small clusters of utricles. From the base of each secondary utricle there arises by a stout outgrowth a medullary filament, which usually ends blindly in the medulla but which may grow back into the cortex and enlarge into a primary utricle. In addition to these fundamental differences, the utricles of *C. papenfussii* are on the average of greater diameter and length than those of *C. bursa,* exhibit a prominent bulge 350—700 μ below the apex, and have apices with a thin or only slightly thickened wall; those of *C. bursa* lack the bulge and frequently have very thick and conspicuously lamellate apical walls. Hairs (or hair scars), which are common in *C. bursa,* are lacking in *C. papenfussii.*

The majority of specimens at hand have been collected in the drift, indicating that this species inhabits off-shore reefs in deep water. According to Miss Pocock (in lit.), it is occasionally found attached under overhanging ledges (Riet River) or in narrow clefts sheltered from direct sunlight (Port Elizabeth: Lighthouse Beach). Miss Duthie also found it attached at Somerset Strand. After storms it may be abundant in the drift (False Bay and Port Elizabeth). Attached intertidal plants are small, firm, and globular compared to the large, flattened, hollow plants usual in the drift.

It is a privilege to name this distinctive species after Professor Papenfuss, in recognition of his many contributions to our knowledge of South African seaweeds and in appreciation of the unlimited patience and enthusiasm with which he guided me through my doctoral programme.

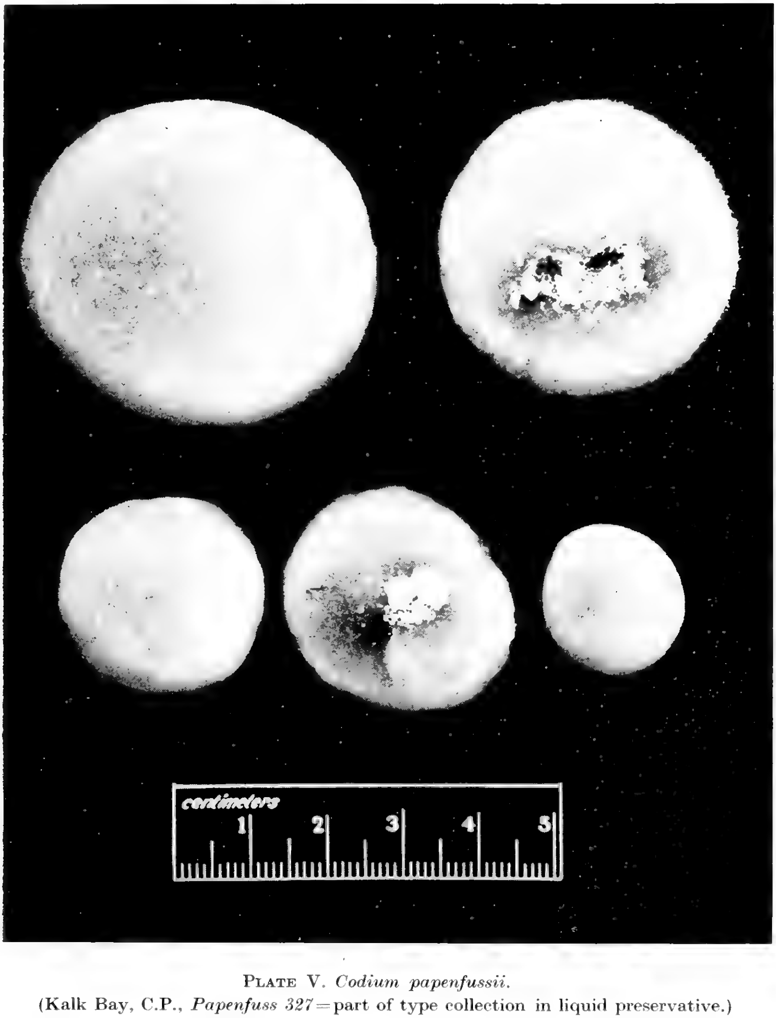

PLATE V. *Codium papenfussii.*
(Kalk Bay, C.P., *Papenfuss 327* = part of type collection in liquid preservative.)

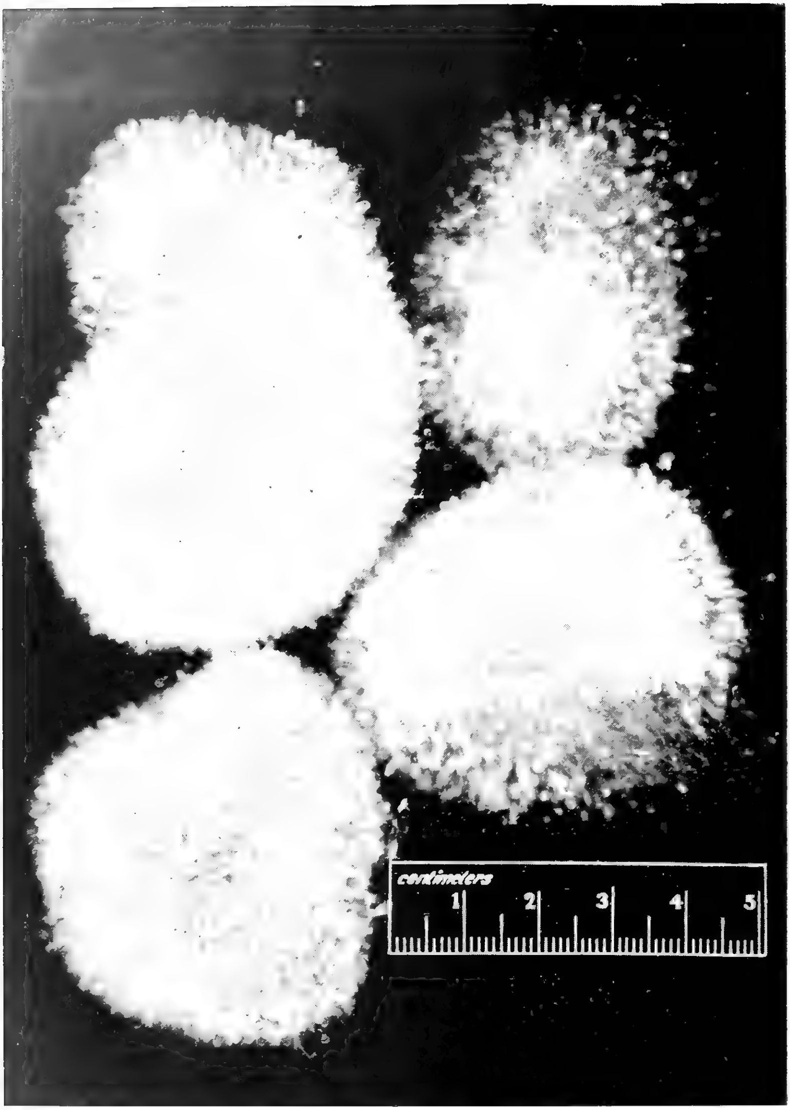

PLATE VI. *Codium megalophysum.*
(Port St. Johns, C.P., *Pocock & Papenfuss 324*=type.)

8. **Codium megalophysum** sp. nov. [Fig. 8, Plate VI]

C. mamillosum Harvey var. *capense* O. C. Schmidt, Bibl. Bot. 23 (91): 37 (1923). (Type=mouth of Illovo River, Natal, xi.1894, *A. Weber-van Bosse*, B, destroyed by fire March 1, 1943; isotypes in L, NY, UC.)

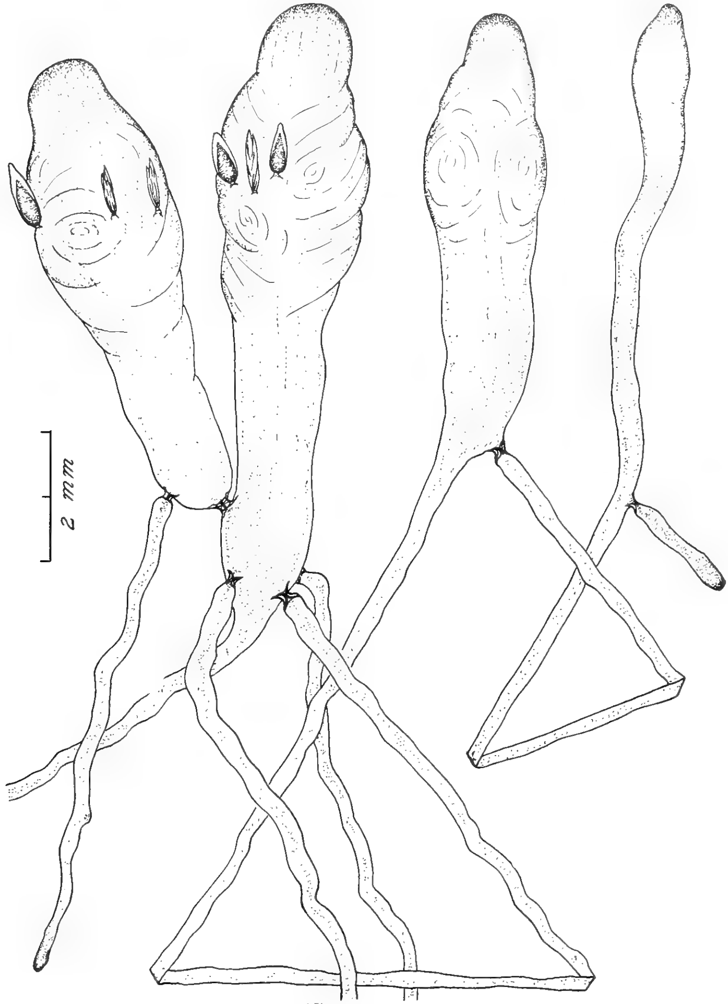

FIG. 8.—*C. megalophysum* (Port St. Johns, C.P., *Pocock & Papenfuss 324*=type). Mature group of utricles.

Records Under Incorrect Determinations.—Barton 1896, p. 459, as *C. mamillosum* (Illovo, *Weber-van Bosse*, L, NY, UC). Levring 1938, p. 6, as *Valonia aegagropila* (Isipingo, *Ecol. Surv. D. 68*, CT). Stephenson 1947, pp. 284 and 296, as *C. mamillosum*, pro parte (Port Edward, *Ecol. Surv. W.6.B*).

Thallus hemisphericus aut globosus laxissimus dilute viridis ad 9·5 cm. diam., substrato per penicillum hapterorum rhizoideorum laxe adhaerens. Utriculi per amplificationem ramorum systematis sympodialis formati; systemata sympodialia secondaria plerumque ita reducta ut utriculi in utriculos parentes directe protentur; utriculi maturi clavati, evaginationibus nodiformibus aut mammiformibus dimidia in superiore praediti, (1—) 1·5—2·7 (—3·9) mm. diam., 5—12 mm. long.; apices rotundati, membrana utricularis relative tenuis (4·5 μ) in apice paululum incrassata (—13 μ). Filamenta medullaria plerumque 215—430 μ diam., pili aut pilorum cicatrices non observati. Gametangia ellipsoidea ovata aut ampulliformia, 190—380 μ diam., 540—1,030 μ long., in pediculis relative brevibus (12—24 μ) portata, aliquot per utriculum, 2—3·5 mm. infra utriculi apicem.

Thallus hemispherical or globose, very loose, light green, to 9·5 cm. diam., loosely adherent to substratum by tuft of rhizoidal holdfasts. Utricles formed by enlargement of branches of a sympodial system; secondary sympodial systems often reduced to the degree that utricles are borne directly on parent utricles; mature utricles clavate, with knobby or mammiform evaginations in upper half, (1—) 1·5—2·7 (—3·9) mm. diam., 5—12 mm. long; apices rounded; utricular wall relatively thin (4·5 μ), slightly thickened at apex (—13 μ). Medullary filaments mostly 215—430 μ diam., hairs or hair scars not observed. Gametangia ellipsoidal, ovoid, or ampulliform, 190—380 μ diam., 540—1,030 μ long, borne on relatively short pedicel (12—24 μ long), several per utricle, 2—3·5 mm. below apex of utricle.

Type.—Port St. Johns, Cape Province, 30.vii.1938, *Pocock & Papenfuss 324* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Known Range.—Port Elizabeth, Cape Province, to Isipingo, Natal.

Representative Collections Examined.—CAPE PROVINCE. Port Elizabeth, drift, 5.xii.1933, *F. Holland* (RU). Amsterdam Hoek (Zwartkops River), 1941, *N. Bryant* (RU). East London (Bats Cave Rocks), 12.vii.1937, *Papenfuss 326*. Dwessa, *H. Rayment* (RU). Port St. Johns, 28.vii.1938, *Pocock & Papenfuss 325*. NATAL. Port Edward, 31.xii.1938, *Ecol. Surv. W.6.B.* Illovo River Mouth, xi.1894, *Weber-van Bosse* (L, NY, UC). Isipingo, 15.vii.1936, *Ecol. Surv. D.68* (CT).

Barton (1896) was the first to record this species, reporting a collection by Mme. Weber-van Bosse from the mouth of the Illovo River under

the name *C. mamillosum.* Schmidt considered the difference in size of the utricles to be of varietal value, and proposed the variety *capense* for the South African plant. Setchell (in manuscript), dealing only with dried specimens, recognized the specific distinctness of the Weber-van Bosse material, but confused this entity with *C. papenfussii.* Levring referred juvenile plants of this species to *Valonia aegagropila.* With ample liquid-preserved material at hand, it is now possible to give an adequate description of this striking plant, one of the most spectacular members of the genus. Its huge utricles (to 3·9 μ diam.) have nearly twice the dimensions of those of *C. mamillosum*, and the gametangia can easily be seen with the naked eye.

On anatomical grounds it must be concluded that *C. megalophysum* is not at all closely related to *C. mamillosum*, but rather has as its nearest relative *C. bursa.* Like *C. bursa*, all utricles are produced by enlargement of branches of sympodial systems and the secondary sympodial systems (i.e., those arising secondarily from mature utricles) may be reduced to the degree that utricles are borne directly on parent utricles (i.e., pairs and triplets of utricles are formed), frequently in *C. megalophysum*, occasionally in *C. bursa.* Each mature utricle may produce a few secondary sympodial systems, most of which are abortive (i.e., they consist of a filament which ends blindly in the medulla). In *C. mamillosum*, by contrast, primary utricles produce secondary or branch utricles by budding from the lower half of the utricle, forming small clusters of utricles. Each derivative utricle develops several very slender filaments which end blindly in the medulla. These filaments are fundamentally different from those in *C. megalophysum* and *C. bursa*, which represent abortive sympodial systems, and unlike those filaments are not plugged at the point of origin (cf. Silva and Womersley 1956, fig. 6).

That *C. megalophysum* is primarily a deep water species, at least in the south-western part of its range, is indicated by the abundance of large thalli cast ashore in the Port Elizabeth region under certain conditions of wind and sea. At other localities it grows in the lower littoral zone in recesses or deep potholes where the thalli are protected from sun and surf. Intertidal plants are on the average smaller than those cast ashore.

9. **Codium pelliculare** sp. nov. [Fig. 9, Plate VII]

C. depressum Papenfuss, Ann. Natal Mus. 11: 284, 296. 1947. *Nomen nudum.*

Thallus applanatus membraniformis tenuis (1·5—3 mm.) solidus rotundatus, marginibus integris aut lobis late rotundatis praeditus, vetus

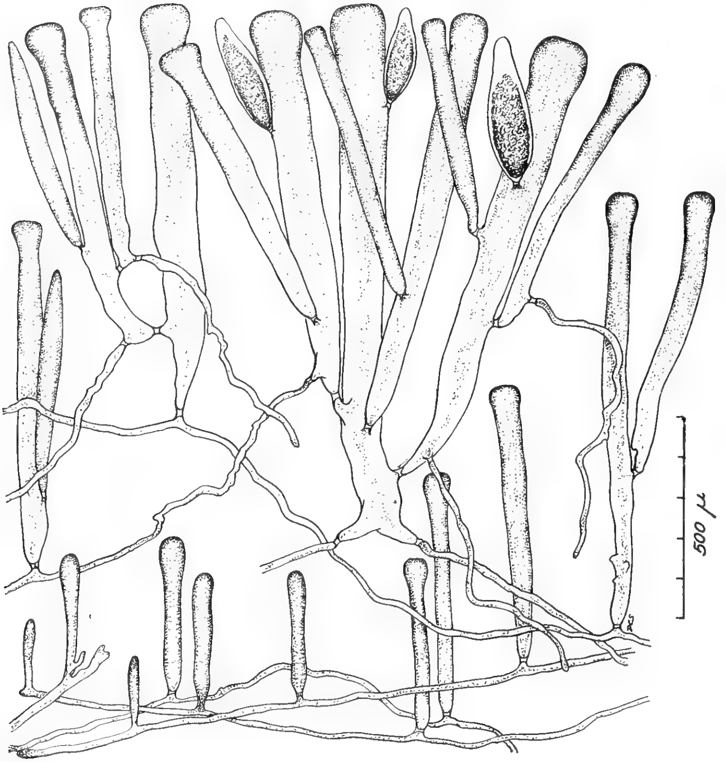

FIG. 9.—*C. pelliculare* (East London, C.P., *Papenfuss 321*). Mature (upper) and juvenile (lower) utricles.

cavus et arena impletus, ad 15 cm. diam. Utriculi primarii per amplificationem ramorum systematum sympodialium formati, obturaculium in loco originis e filamento evolutum; utriculi secondarii ut gemmae e parte media aut inferiore utriculorum primariorum vel derivativorum orientes, fasces parvos utriculorum genetice similium formantes; utriculi secondarii singuli interdum filamenta medullaria producentes, per excrescentiam tenuem e basi utriculi orientia, obturaculium in loco originis ex utriculo evolutum. Utriculi iuniores anguste clavati, ad apicem expansi, saepe infra apicem paululum constricti, (50—) 75—125 (—165) μ diam., 700—1,100 (—1,350) μ long.; utriculi vetustiores latiores, prope partem mediam saepe latissimi; apices truncati, depressi aut aliquantulum rotundati;

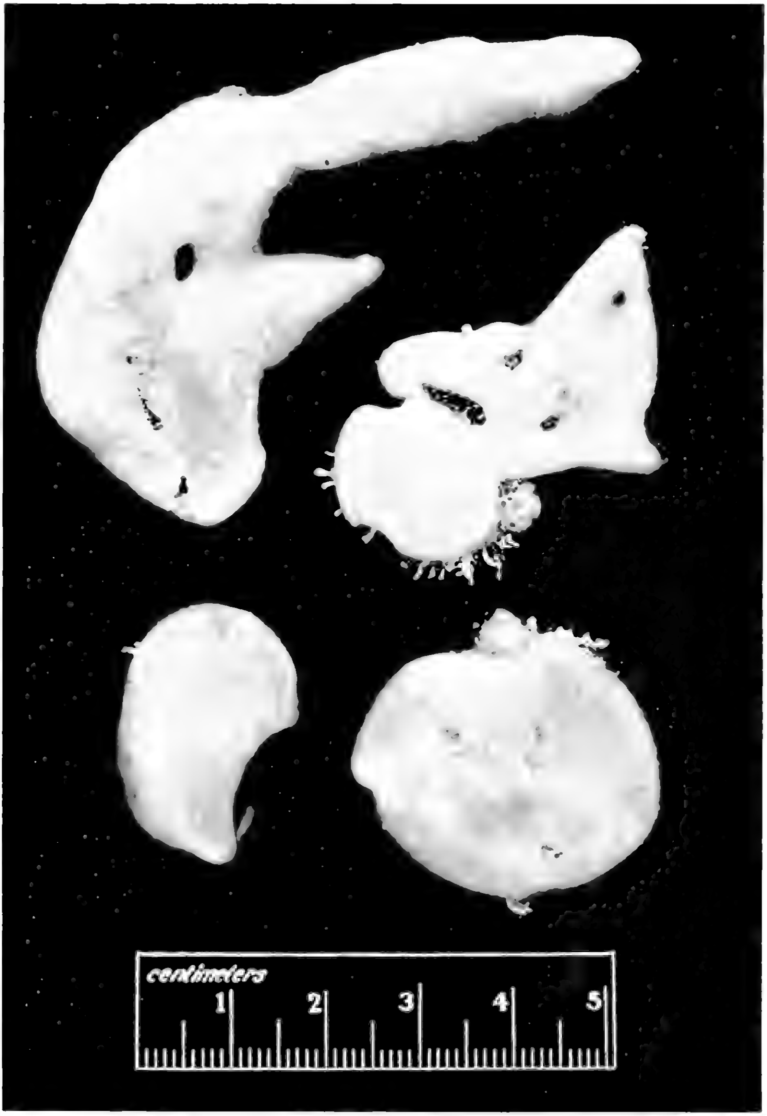

PLATE VII. *Codium pelliculare.*
(Bats Cave Rocks, East London, C.P., *Papenfuss 321*=part of type collection in liquid preservative.)

membrana utricularis tenuis (1—1·5 μ) ad apices vix incrassata (—7 μ); utriculi secondarii pro portione minores. Pili absentes. Filamenta medullaria plerumque 12—25 μ diam. Gametangia lanceo-ovata ad fusiformia, 55—130 μ diam., 230—410 μ long., 1 (—3) per utriculum, omnia in pediculis circa 15—20 μ long., 265—440 μ infra apicem portata.

Thallus applanate, membraniform, thin (1·5—3 mm.), firm, rotund and with entire margins or with broadly rounded lobes, becoming hollow and filled with sand when old, to 15 cm. diam. Primary utricles formed by enlargement of branches of sympodial systems, plug developing at point of origin from filament; secondary utricles arising as buds from middle or lower portion of primary utricles or their derivatives, forming small clusters of utricles; secondary utricles sometimes each producing a medullary filament, arising by slender outgrowth from base of utricle, plug developing at point of origin from utricle. Younger utricles narrowly clavate, expanded at apex, often slightly constricted below apex, (50—) 75—125 (—165) μ diam., 700—1,100 (—1,350) μ long; older utricles of greater diameter, often broadest near middle; apices truncate, depressed, or slightly rounded; utricular wall thin (1—1·5 μ), at apices very slightly thickened (—7 μ); secondary utricles proportionately smaller. Hairs absent. Medullary filaments mostly 12—25 μ diam. Gametangia lance-ovoid to fusiform, 55—130 μ diam., 230—410 μ long, 1 (—3) per utricle, each borne on pedicel about 15—20 μ long, 265—440 μ below apex of utricle.

Type.—East London (Bats Cave Rocks), Cape Province, 16.vii.1937, *Papenfuss 321* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Known Range.—Cape Province: Arniston to Port St. Johns.

Representative Collections Examined.—CAPE PROVINCE. Arniston, 20.ii.1939, *Pocock 524B*. Jeffreys Bay, 8.v.1927, *W. A. Setchell*. Riet River Mouth (Three Sisters), 2.x.1943, *Pocock 6943* (MAP). East London (Bats Cave Rocks), 10.vii.1937, *Ecol. Surv. L.59*. Morgan Bay, 3.x.1951, *Pocock 9450*. Cape Morgan, 29.ix.1939, *Pocock 1847* (MAP). Port St. Johns, 30.xii.1952, *Isaac B.484*.

This extraordinary species has escaped the notice of all but a few collectors. The single specimen collected by Setchell at Jeffreys Bay was designated by him as the type of a manuscript species, which he confused with material referable to *C. lucasii* subsp. *capense*. Setchell's notes read: "on sand-covered rocks, in littoral zone . . . the thallus is applanate, fairly smooth, and rather firm. It is attached over its entire lower surface, but comes away readily from the substratum because of the layer of sand beneath it. It is dark green in color and fairly regular [in] outline, orbicular to elongated elliptical." Dr. Papenfuss informs me that the thalli grow on a turf of stubby corallines and other algae in shaded pools

on platforms of the lower littoral zone. The thallus is exceedingly thin, becoming translucent when dry.

C. pelliculare is unique in the genus both in gross morphology and in anatomy. Its membraniform habit is striking, and Miss Pocock has appropriately dubbed it the "beret" *Codium*. The clusters of utricles into which the thallus dissects are essentially the same in origin as those found occasionally in *C. bursa* and frequently in *C. megalophysum*: secondary sympodial systems abort to the degree that utricles are borne directly on parent utricles. This method of cluster formation is in fundamental distinction to that found in *C. acuminatum, C. mozambiquense, C. lucasii, C. stephensiae, C. incognitum, C. spongiosum, C. papenfussii* and all other members of the sections of the genus to which these species belong. (Sectional relationships are not discussed in this paper.) In these species secondary utricles (i.e., branch utricles) arise as buds from existing utricles. At the base of each utricle there is initiated by a broad outgrowth a single filament which either buries itself in the medulla or behaves as a sympodial branching system, giving rise to additional primary utricles: in either situation a plug is never formed at the point of origin of the filament. The extent of cluster formation in *C. pelliculare* is far greater than in either *C. megalophysum* or *C. bursa*. Moreover, there is a marked disparity in size among utricles of different orders of branching, which is not the case in those two species. Unlike *C. megalophysum*, in which nearly every utricle produces a filament (as part of a functional or abortive sympodial system), but like *C. bursa*, in *C. pelliculare* many derivative utricles do not produce such filaments. Finally, *C. pelliculare* is unique in that in sympodial systems a plug forms at the base of each developing utricle rather than at the point of departure of the lateral branch (new growing point) from the old apex, as in all other species of the genus.

10. **Codium platylobium** J. E. Areschoug, Nova Acta Reg. Soc. Sc. Upsal., ser. 3, 1: 367 (1854). De Toni 1889, p. 497. Barton 1893, p. 82 (Port Elizabeth, 1893, *Farquhar 1*, BM; Algoa Bay, 1884, *Herb. Dickie*, BM; Cape Morgan, 1892, *Flanagan 32*, BM). Papenfuss 1940, p. 204, fig. 4. Isaac 1942, p. 234. [Fig. 10, Plates VIII and IX]

C. elongatum C. Agardh δ *palmatifidum* Kuetzing, Sp. Alg. 501 (1849). (Type=Table Bay, *Binder*, L.)

C. lindenbergii Binder ex Kuetzing, Tab. Phyc. 6: 34, pl. 97 (1856). (Type=Table Bay, *Binder*, L.) J. Agardh 1887, p. 46. De Toni 1889, p. 497. Barton 1896, p. 194, excl. Port Elizabeth record (Cape Morgan, *Flanagan 248*, BM; Kowie, *H. Becker*, BOL). Delf and Michell 1921, p. 95, excl. False Bay record (Algoa Bay, East London, Kowie, *W. Tyson*,

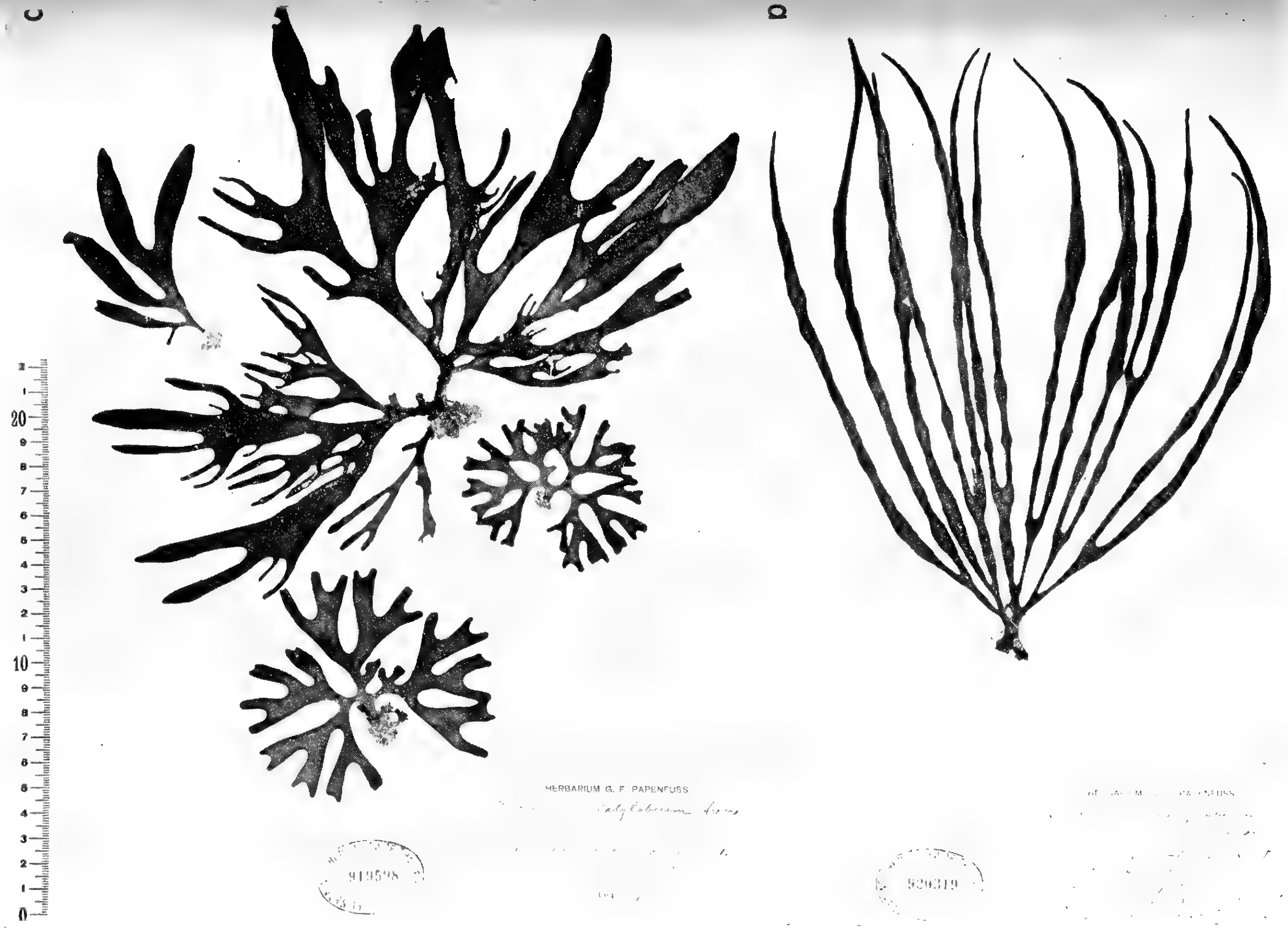

PLATE VIII. *Codium platylobium*.

a (Port St. Johns, C.P., *Pocock & Papenfuss 355*): plant with linear segments; *b* (Bats Cave Rocks, East London, C.P., *Papenfuss 337*): sheet with three young plants and an older proliferous plant.

PLATE IX. *Codium platylobium.*
(Strandfontein, False Bay, C. P., *Papenfuss 340.*) Plant cast up from sublittoral with broad eroded segments becoming proliferous.

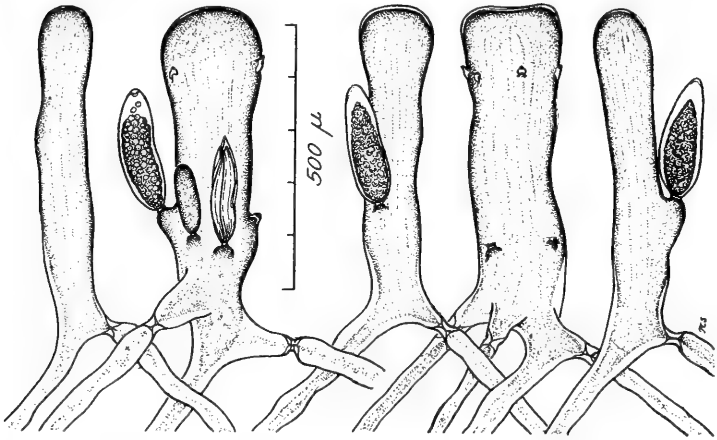

FIG. 10.—*C. platylobium* (Kalk Bay, C.P., *Papenfuss 344*). Mature utricles from standard sample.

BOL). Schmidt 1923, p. 60, fig. 43. Stephenson, Stephenson, and Bright 1938, pp. 5 and 7. Eyre, Broekhuysen, and Crichton 1938, p. 92. Pocock 1939, pp. 76 and 78. Stephenson 1939, p. 505. Stephenson 1944, pp. 317 and 349. Stephenson 1947, pp. 283 and 296.

Records Under Incorrect Determinations.—Kützing 1856, p. 34, pl. 98, as *C. damaecorne* (Kalk Bay, *Pappe*, L). Grunow 1867, p. 35, as *C. elongatum* var. *damaecornis* (Simons Bay, *Novara Exped.*, W). Barton 1893, p. 82, as *C. elongatum* (Kalk Bay, *Pappe*, L). Delf and Michell 1921, p. 95, as *C. tomentosum*, Table Bay record only (*W. Tyson*, BOL).

Excluded Records.—Barton 1893, p. 82, as *C. lindenbergii*=*C. fragile* subsp. *capense* (Cape of Good Hope, 1884, *Herb. Dickie*, BM). Barton 1896, p. 194, as *C. lindenbergii*, Port Elizabeth record only=*C. duthieae* (1893, *Farquhar 4*, BM). Delf 1921, p. 58, as *C. lindenbergii*=*C. stephensiae* (identity inferred from locality). Delf and Michell 1921, p. 95, as *C. lindenbergii*, False Bay record only=*C. stephensiae* (Gordons Bay, *W. Tyson*, BOL).

Thallus erect, entirely complanate and dichotomously branched (to eight orders) above a terete stipe; stipe 1—2·5 (—7) cm. long, terete at base, flattened above to form cuneate apophysis; segments of frond 3 mm. to 24 cm. broad, 1·5—2 mm. thick, to 2 m. long, linear-lanceolate, acute when young, becoming blunt from erosion when old, occasionally bearing simple or dichotomously divided proliferations on terminal and

lateral margins. Thallus dissecting out into individual utricles; utricles* cylindrical or slightly clavate, usually expanded at apex, (65—) 115—330 (—460) μ diam., (375—) 500—750 (—840) μ long; apices truncate, depressed, or slightly rounded; utricular wall 1·5 μ thick, at apices slightly thickened (5—15 μ), rarely moderately thickened (—35 μ) and lamellate. Hairs (or hair scars) occasional, one to few per utricle, borne 80—140 μ below apex. Medullary filaments mostly 26—60 (—85) μ diam., usually several arising from base of older utricles by slender outgrowths. Gametangia lance-ovoid or ellipsoidal, 55—90 μ diam., 180—250 μ long, several per utricle, each borne on conspicuous pedicel at or below middle of utricle.

Type.—"Ad oram Africae australis in sinu Algoa prope Port Elisabeth . . . " (Areschoug). Lectotype chosen and figured by Papenfuss (1940) collected by Fr. Hjärne, ii.1854 (S).

Known Range.—Table Bay, Cape Province, to the mouth of the Umtwalumi River, Natal.

Representative Collections Examined.—CAPE PROVINCE. Table Bay, *W. Tyson* (BOL). False Bay: Froggy Pond, 24.i.1937, *Papenfuss 346*; Fish Hoek, 24.i.1937, *Papenfuss 347*; Kalk Bay, 20.vii.1936, *Papenfuss 344*; Strandfontein, 12.ii.1938, *Papenfuss 340*; Somerset Strand, iv.1929, *J. D. Rossouw.* Struis Bay Beach, 27.ii.1937, *Papenfuss 342.* Reef Bay (near Port Elizabeth), 5.vii.1936, *Ecol. Surv. E.30.* Humewood (near Port Elizabeth), 1.i.1937, *V. J. G. Steyn.* Port Elizabeth, *A. Weber-van Bosse* (L). Algoa Bay, *W. Tyson*, South African Marine Algae No. 55, as *C. lindenbergii* (BOL, HBG, K, PC, UC). Port Alfred, 4.vii.1896, *H. Becker* (BOL, M, PC). Kleinmond, 19.iii.1939, *Ecol. Surv. X.1.B.* East London (Shelly Beach), 8.vii.1937, *Ecol. Surv. L.34.* Bonza Bay, 27.vii.1937, *Papenfuss 341.* Morgan Bay, 1.x.1951, *Pocock 9403.* Keimouth, 22.vii.1937, *Papenfuss 170.* Qolora, 20.v.1939, *Ecol. Surv. QQ.1.U.* Dwessa, iv.1938, *Rayment 213A.* Bashee River Mouth, 26.ix.1939, *Pocock 1673.* Port St. Johns, 6.vii.1938, *Pocock & Papenfuss 355.* NATAL. Port Shepstone, 27.vii.1938, *Pocock & Papenfuss 248* (UC only). Hibberdene, 30.x.1951, *Pocock 9981.* Mouth of Umtwalumi River, 25.xii.1938, *Ecol. Surv. M.1.C.*

C. platylobium has been known, under various names, for more than a century. It was first described by Kützing (1849) as a variety of *C. elongatum*, based on a specimen in Binder's herbarium bearing the manuscript name *C. lindenbergii.* Kützing later (1856) recognized it as a distinct species, employing Binder's manuscript name. At the same time

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*Descriptions of utricles of dichotomously branched species are based on samples taken about 2 cm. below the tip of a branch ("standard sample"), unless otherwise specified.

he considered as a separate species a specimen collected by Pappe at Kalk Bay (not Table Bay, as erroneously cited by Kützing), assigning it to *C. elongatum* var. *damaecorne* Bory ex Montagne (1846), which he elevated to specific rank. Bory's variety (from Algeria), to judge from specimens in Herbier Bornet-Thuret (PC), is referable to *C. decorticatum* (Woodw.) Howe. The Kalk Bay specimen (Kützing 1856, pl. 98) is clearly referable to *C. platylobium* and is an old plant with broad, eroded segments bearing proliferations in contrast to the young plant with narrow, pointed segments illustrated by Kützing (pl. 97) as *C. lindenbergii.* Kützing remarked on the anatomical agreement, and obviously distinguished the two species on gross morphology. In the meanwhile Areschoug (1854) had described *C. platylobium.* J. Agardh (1887) was the first to merge all three species (*C. lindenbergii, C. damaecorne* sensu Kützing, and *C. platylobium*). He retained the name *C. lindenbergii*, but incorrectly, inasmuch as *C. platylobium* has priority, as emphasized by Papenfuss (1940).

In the eastern part of its range *C. platylobium* grows in pools and channels of the sublittoral fringe in partially protected situations. West of Jeffreys Bay it is known only from drift, except for one plant found attached at Strandfontein, indicating a deeper habitat in this part of its range (Stephenson 1947, p. 296). Specimens cast ashore generally are larger and have broader segments than those growing in the sublittoral fringe (compare Plates VII, *a* and VIII). Although rock is the usual substratum, plants epiphytic on sea grass, *Gelidium*, and other algae have been collected (Port Shepstone, *Pocock & Papenfuss 248*).

Hariot (1891, p. 216), following the suggestion of Suringar (1870, p. 22), reduced *C. latum* of Japan to *C. lindenbergii*, thereby initiating a series of incorrect records for the latter species (De Toni 1895, p. 64; Matsumura 1895, p. 88; Matsumura 1904, p. 52). In habit as well as in anatomy the two species are readily distinguishable, though clearly related. In *C. platylobium* the thallus is dichotomous to as many as eight orders and the segments are linear-lanceolate; the thallus of *C. latum* is simple or only once to thrice divided and the segments are reniform, falcate, or cuneate. The utricles of *C. platylobium* are much stouter than those of *C. latum.* Hariot did not have *C. latum* in hand, however; I agree with Yamada (1931, p. 1) that the specimen upon which Hariot's record is based (Yokosuka, *Savatier*, PC) is referable to *C. divaricatum* Holmes, a species which is not at all closely related to either *C. latum* or *C. platylobium.*

11. **Codium prostratum** Levring, Lunds Univ. Årsskr. 34 (Afd. 2, Nr 9): 16, pl. 4, fig. 11, text-figs. 8 *a—d* (1937). Eyre and Stephenson

1938, p. 33. Stephenson 1944, p. 349. Stephenson 1947, pp. 284 and 296. Pocock 1958, p. 25. [Fig. 11, Plate X]

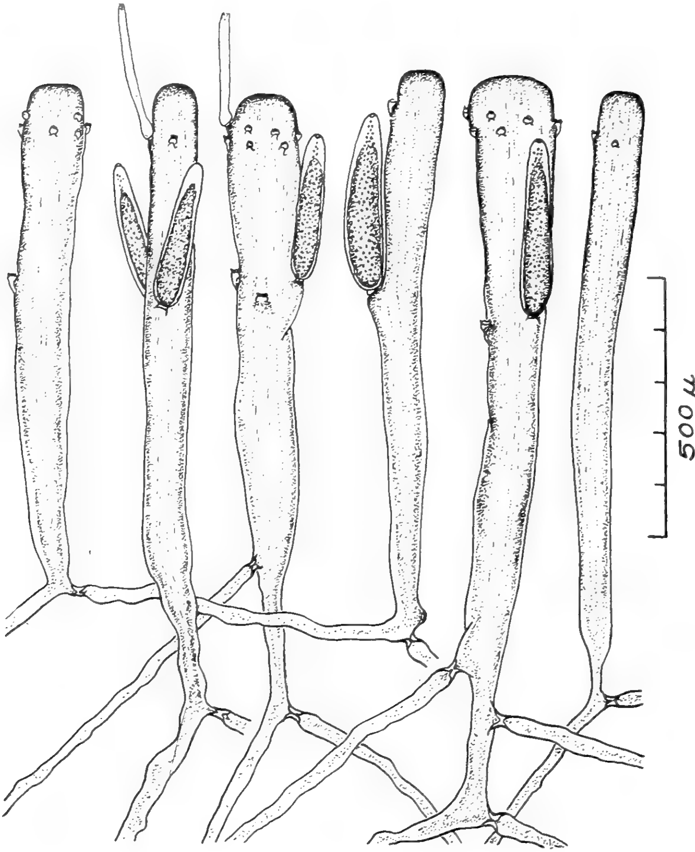


FIG. 11.—*C. prostratum* (Umhlali, Natal, *Ecol. Surv. U.19.B*). Mature utricles from standard sample.

Thallus repent (rarely erect), subdichotomously branched, to 16 cm. across; branches terete or somewhat compressed, finger-like, overlapping, anastomosing, 3—9 mm. thick. Thallus dissecting out into individual utricles; utricles subcylindrical or slightly clavate, often tapering markedly toward their base, 65—183 μ diam., 720—1,310 μ long, 6—14·5 × long as broad; apices truncate to slightly rounded; utricular wall about 1·5 μ

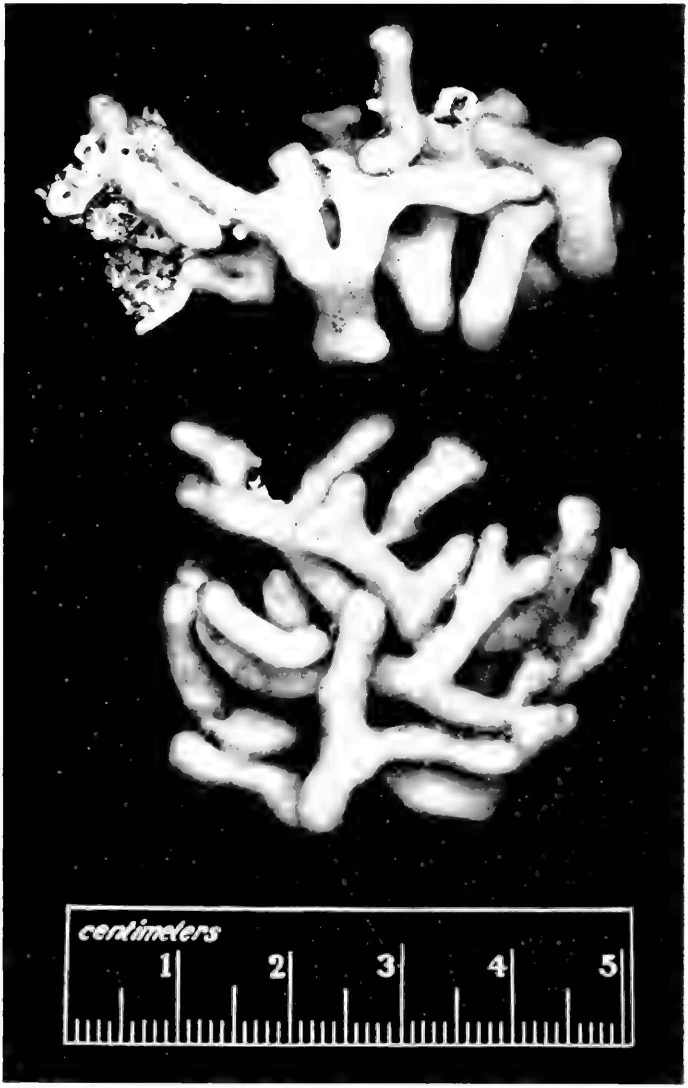


PLATE X. *Codium prostratum.*
(Umpangazi, Natal, *Ecol. Surv. G.5.A*: in liquid preservative.)

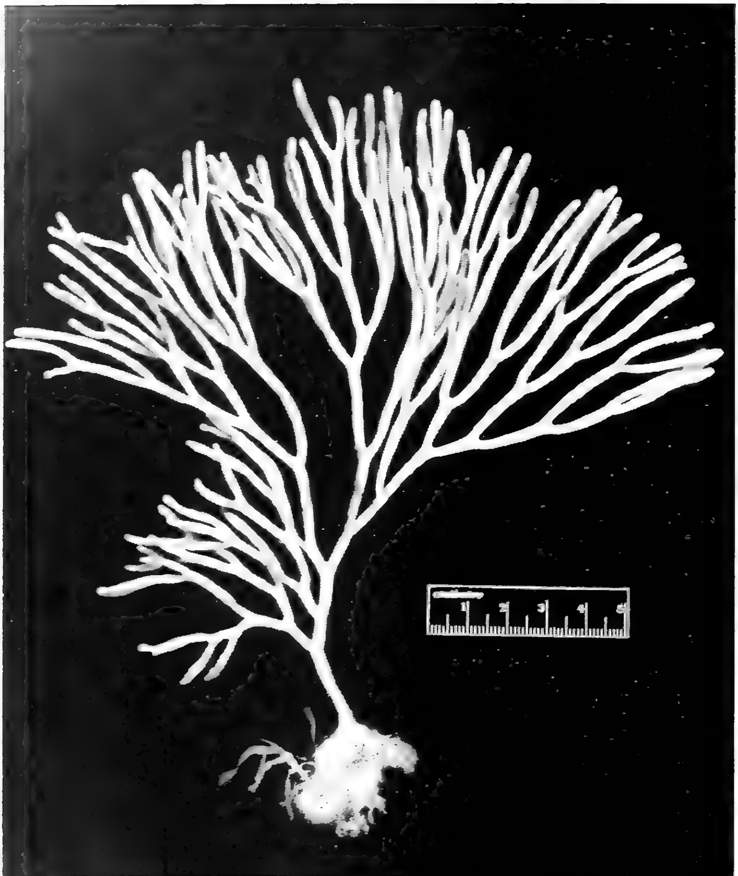


PLATE XI. *Codium capitatum.*
(Umhlali, Natal, *Ecol. Surv. U.20.A*: in liquid preservative.)

thick, at apices usually very slightly thickened (to 2 or 3 μ), rarely moderately to markedly thickened (—35 μ). Hairs (or hair scars) abundant, one to several (—9) per utricle, borne in zone 80—130 μ below apex. Medullary filaments mostly 20—35 μ diam. Gametangia lance-ovoid or more usually subcylindrical, 33—72 μ diam., 235—365 μ long, 1—3 per utricle, each borne on pedicel about 7—9 μ long on protuberance 250—460 μ below apex of utricle.

Type.—Isipingo, Natal, 28.vi.1935, *Ecol. Surv. D.21* (Herb. Levring; isotype in CT).

Known Range.—Dwessa, Cape Province, to Cabo Inhaca, Mozambique.

Representative Collections Examined.—CAPE PROVINCE. Dwessa, 14.i.1953, *Isaac B.471.* Bashee River Mouth, 26.ix.1939, *Pocock 1672* Port St. Johns, 28.vii.1938, *Pocock & Papenfuss 352* (UC only). NATAL.. Port Shepstone, 27.vii.1938, *Pocock & Papenfuss 351* (UC only). Hibberdene, 30.x.1951, *Pocock 9983.* Reunion Rocks, 3.viii.1929, *E. Forbes.* Durban (The Bluff), 15.vii.1938, *Pocock & Papenfuss 353.* Umhlanga Rocks, 11.vii.1938, *Pocock & Papenfuss 349* (UC only). Umhloti Beach, 8.vii.1938, *Pocock & Papenfuss 1144.* Umhlali, 23.xii.1938, *Ecol. Surv. U.19.B.* Umpangazi, 4.v.1939, *Ecol. Surv. G.5.A.* Cape St. Lucia, x.1951, *Pocock 10596* (MAP). Sandstone reef near Big Kosi Bay, 25.v.1948, *Rodin 4630.* MOZAMBIQUE. Cabo Inhaca, v.1953, leg. W. Macnae, comm. *Pocock 10582.*

The repent, anastomosing, subdichotomously branching thallus of *C. prostratum* immediately distinguishes this species from all other representatives of the genus in South Africa. Anatomically, the long slender utricles are distinctive. *C. vaughanii* Børgesen (1940, p. 70) from Mauritius is a very close relative.

C. prostratum grows in pools and on sand-covered rock terraces of the lowest littoral zone.

12. **Codium capitatum** sp. nov.

C. collare Papenfuss, Ann. Natal Mus. 11: 283 and 296. 1947. *Nomen nudum. C. capitatum* Silva in Pocock in Macnae and Kalk (ed.), A Natural History of Inhaca Island, Moçambique, p. 24 (1958). *Nomen nudum.*

Records Under Incorrect Determinations.—Krauss 1846, p. 214, as *C. tomentosum*, Natal Bay record only ("Port Natal" [Durban], 1839, *Krauss*, AG, L, M). Areschoug 1851, p. 6, as *C. tomentosum*, Krauss reference only, pro parte. Barton 1893, p. 82, as *C. tomentosum*, Natal (*Krauss*) record only. Schmidt 1923, p. 40, as *C. tomentosum*, Port Natal (*Krauss*) record only. Vouk 1936, p. 19, as *C. dichotomum* f. *intermedium*,

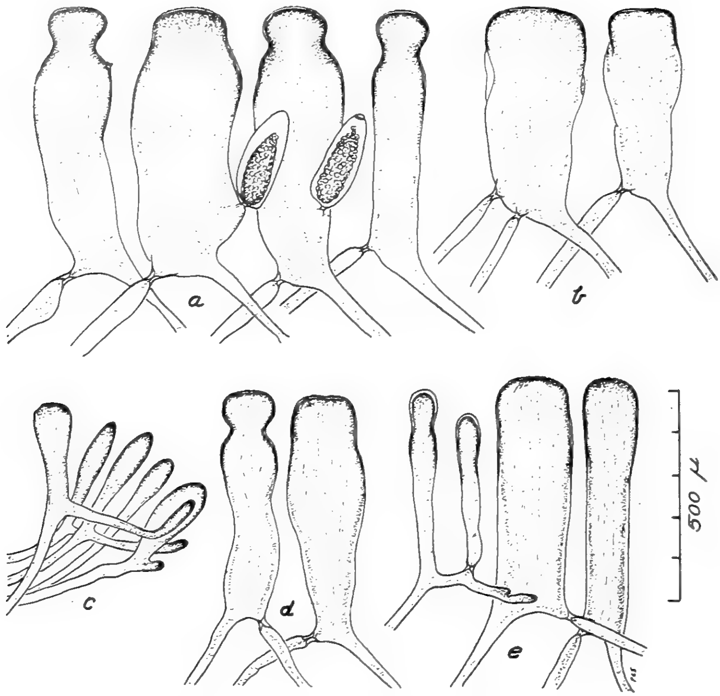


FIG. 12.—*C. capitatum*. *a* (Umhlanga Rocks, Natal, *Pocock & Papenfuss 231*= type), mature utricles from standard sample; *b* (Cape St. Lucia, Natal, *Pocock 10595*), mature utricles from standard sample; *c*, *d*, *e* (Umpangazi, Natal, *Ecol. Surv. G.1.K*): *c*, utricles from tip of thallus; *d*, utricles from standard sample; *e*, utricles from base of thallus.

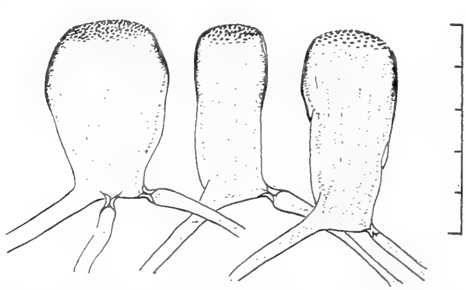


FIG. 13.—*C. capitatum* (Umhloti Beach, Natal, *Pocock & Papenfuss 230*). Utricles from standard sample.

Port Natal records only (B, annotated by Vouk). Levring 1938, p. 16, as *C. dichotomum*, pro parte; Eyre and Stephenson 1938, p. 33, as *C. dichotomum*, pro parte (Isipingo, *Ecol. Surv. D.4*, pro parte). Stephenson 1944, as *C. tenue*, p. 300; p. 350, pro parte; 1947, pp. 283 and 296, pro parte (Umhlali, *Ecol. Surv. U.20.A*).

Thallus erectus ad 35 cm. alt. proxime super basim haptericam latam spongiosam plus minusque regulariter dichotome ramosus; rami intervallis circa 3—4 mm. constrictiones saepe praebentes, aliter, autem, uniformiter teretes 2—3·5 mm. diam. Thallus extrinsecus in utriculos singulos dissectus; utriculi cylindrici aut paululum clavati, in regione 80—110 μ infra apicem capitulum formantes saepe perspicue constricti, interdum infra collum valde inflati, 100—215 μ diam. super constrictionem, 115—260 μ infra constrictionem, 340—715 μ long., 2—5 plo longiores quam lati, apicibus rotundatis; membrana utricularis 2 μ crass., in triente superiore utriculi conspicue incrassata facta, ad apicem ad 10 μ crass., plerumque externe verruculosa aut foveolata. Pili (aut pilorum cicatrices) rari, quando adsunt 1—2 (—4) per utriculum in zona 90—190 μ infra apicem in humero infra constrictionem dispositi. Filamenta medullaria plerumque 20—35 (—40) μ diam. Gametangia ovata aut ellipsoidea aut fusiformia, ad basem saepe asymmetrica, 70—105 μ diam., 170—285 μ long., 1—2 per utriculum, omnia in pediculis circa 8—12 μ long. in protuberatione circa 2/3 longitudinis utriculi ab apice (360—515 μ infra apicem) portata.

Thallus erect, to 35 cm. high, more or less regularly dichotomously branched immediately above a broad spongy hapteric base; branches often showing constrictions at intervals approximating 3—4 mm., but otherwise uniformly terete, 2—3·5 mm. diam. Thallus dissecting out into individual utricles; utricles cylindrical or slightly clavate, often distinctly constricted in region 80—110 μ below apex, forming a capitulum, at times markedly inflated below neck, 100—215 μ diam. above constriction, 115—260 μ diam. below constriction, 340—715 μ long, 2—5 × long as broad, with rounded apices; utricular wall 2μ thick, becoming conspicuously thickened in upper third of utricle, to 10 μ thick at apex, usually externally verruculose or foveolate. Hairs (or hair scars) not common, when present occurring 1—2 (—4) per utricle in zone 90—190 μ below apex, on shoulder below constriction. Medullary filaments mostly 20—35 (—40) μ diam. Gametangia ovoid, ellipsoidal, or fusiform, frequently asymmetrical at base, 70—105 μ diam., 170—285 μ long, 1—2 per utricle, each borne on pedicel about 8—12 μ long on protuberance about 2/3 length of utricle from apex (360—515 μ below apex).

Type.—Umhlanga Rocks, Natal, 10.vii.1938, *Pocock & Papenfuss 231* (UC; isotypes in BOL, BM, L, MAP).

Known Range.—Port St. Johns, Cape Province, to Cabo Inhaca, Mozambique.

Representative Collections Examined.—CAPE PROVINCE. Port St. Johns, 29.vii.1938, *Pocock & Papenfuss 244.* NATAL. Hibberdene, 30.x.1951, *Pocock 9984.* Isipingo, 27.vi.1935, *Ecol. Surv. D.4,* pro parte. Reunion Rocks, 13.x.1951, *Pocock 9514.* Durban (The Bluff), 15.vii.1938. *Pocock & Papenfuss 232;* Umhloti Beach, 9.vii.1938, *Pocock & Papenfuss 230.* Umhlali, 23.xii.1938, *Ecol. Surv. U.20.A.* Umpangazi, 2.v.1939. *Ecol. Surv. G.1.K.* St. Lucia (Crayfish Point), 21.vii.1938, *Pocock & Papenfuss 235* (UC only). Perrier's Rocks, 22.vii.1938, *Pocock & Papenfuss 348* (UC only). MOZAMBIQUE. Cabo Inhaca, v.1953, leg. W. Macnae, comm. *Pocock 10580.*

The earliest collection of *C. capitatum* is that by Krauss at Port Natal (Durban) in 1839, reported by him under the name *C. tomentosum.* In determinations made for the Ecological Survey this species was confused with *C. tenue.* The regularly capitate, often externally foveolate utricles set this species apart from all other dichotomous members of the genus. Utricles from lower parts of the thallus and those from juvenile plants are not so conspicuously capitate. The first 80—100 μ distance of utricle may be of uniform diameter, below which the utricle bulges, reaching a maximum diameter 185—220 μ below the apex. The most conspicuously foveolate or verruculose utricles seem to be those which are least conspicuously capitate. The thallus when being dissected has a keratinous texture. In the field this species is recognizable by its slender, regularly dichotomous branches whose diameter scarcely varies from base to apex, except for the regular constrictions exhibited by certain plants.

C. capitatum grows in the deeper pools of the platforms of the lower littoral zone.

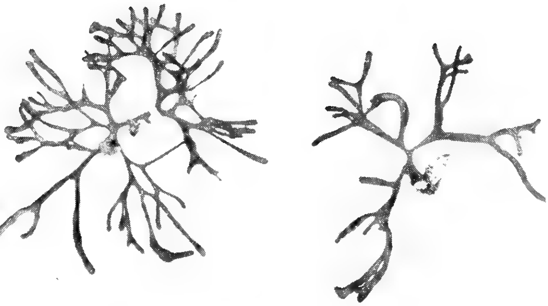
13. **Codium pocockiae** sp. nov. [Fig. 14, Plate XII, *b*]

C. pocockiae Silva in Pocock in Macnae & Kalk (ed.), A Natural History of Inhaca Island, Moçambique, p. 25 (1958). *Nomen nudum.*

Records Under Incorrect Determinations.—Levring 1938, p. 16, as *C. dichotomum,* pro parte; Eyre and Stephenson 1938, p. 33, as *C. dichotomum.* pro parte (Isipingo, *Ecol. Surv. D.4,* pro parte; *D.21.A,* CT).

Thallus erectus, 4—10 cm. alt. divaricate dichotome ramosus, ramis ambobus dichotomiae plerumque non aeque evolutis, itaque ramificatio velut cervicornigera videtur, ramis latitudine inaequalibus, 3—7 mm. lat., quasi complanatis praecipue inferiore in parte. Thallus extrinsecus in utriculos singulos dissectus; utriculi clavati tenues (65—) 105—235

a



b

Plate XII.

a, *Codium cicatrix* (Ponta Rasa, Mozambique, *Pocock 12279*=holotype); *b*, *Codium pocockiae* (Port St. Johns, C.P., *Pocock & Papenfuss 245*=holotype).

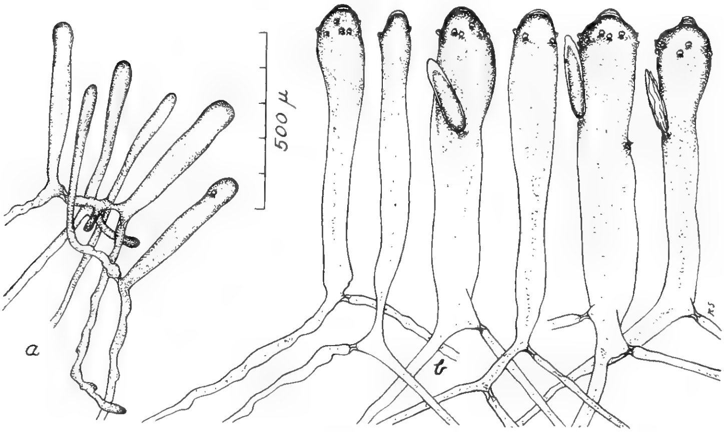


FIG. 14.—*C. pocockiae* (Cabo Inhaca, Mozambique, *Pocock 12288*). *a*, utricles from tip of thallus; *b*, utricles from standard sample.

(—300) μ diam., (500—) 650—1,050 (—1,250) μ long., apicibus rotundatis ad subacutos, membrana utricularis 1·5—2 μ crass., ad apices paululum ad modice incrassata (—35 μ), saepe asymmetrice incrassata, lamellata. Pili (aut pilorum cicatrices) frequentes, duo ad aliquot per utriculum, in zona 50—105 μ infra apicem portati. Filamenta medullaria plerumque 22—39 μ diam. Gametangia ellipsoidea, cylindrica aut lanceo-ovata (35—) 50—80 u diam., 225—260 (—350) μ long., 1—2 (—3) per utriculum, omnia in pediculis brevibus (circa 7 μ long.) in protuberatione parva (260—) 285—485 μ infra utriculi apicem portata.

Thallus erect, 4—10 cm. high, divaricately dichotomously branched, the two branches of a dichotomy usually not equally developed and the branching thus appearing cervicorn, branches of uneven width, 3—7 mm. broad, somewhat flattened, especially in lower part. Thallus dissecting out into individual utricles; utricles clavate, slender, (65—) 105—235 (—300) μ diam., (500—) 650—1,050 (—1,250) μ long, apices rounded to subacute; utricular wall 1·5—2 μ thick, at apices slightly to moderately thickened (—35 μ), often asymmetrically thickened, lamellate. Hairs (or hair scars) common, two to several per utricle, borne in zone 50—105 μ below apex. Medullary filaments mostly 22—39 μ diam. Gametangia ellipsoidal, cylindrical, or lance-ovoid, (35—) 50—80 μ diam., 225—260 (—350) μ long, 1—2 (—3) per utricle, each borne on short pedicel (about 7 μ long) on slight protuberance (260—) 285—485 μ below apex of utricle.

Type.—Port St. Johns, Cape Province, 29.vii.1938, *Pocock & Papenfuss 245* (UC).

Known Range.—Port St. Johns, Cape Province, to mouth of Limpopo River, Mozambique.

Representative Collections Examined.—CAPE PROVINCE. Port St. Johns, 30.vii.1938, *Pocock & Papenfuss 247* (UC only). NATAL. Port Shepstone, 27.vii.1938, *Pocock & Papenfuss 240* (UC only). Illovo River Mouth, xi.1894, *A. Weber-van Bosse* (L). Reunion Rocks, 13.x.1951, *Pocock 10602* (MAP). Isipingo, 27.vi.1935, *Ecol. Surv. D.4*, pro parte; *D.21.A* (CT). Umhloti Beach, 9.vii.1938, *Pocock & Papenfuss 366* (UC only). Umpangazi, 2.v.1939, *Ecol. Surv. G.4.B.* St. Lucia (Crayfish Point), 21.vii.1938, *Pocock & Papenfuss 365* (UC only). Kosi Bay, 25.v.1948, *R. J. Rodin.* MOZAMBIQUE. Cabo Inhaca, 26. ix. 1957, *Pocock 12288.* Vila de João Belo, near mouth of Limpopo River, viii.1936, *G. C. Nel.*

The long clavate utricles with markedly and often asymmetrically thickened apices distinguish this species anatomically. The disparity of size of utricles within a sample often is striking. In the field this species is readily distinguishable from all other members of the genus in South Africa by its divaricately dichotomous branching in which the two branches of a dichotomy are often very unequally developed and of uneven width. *C. pocockiae* is closely related to *C. taylori* Silva ined. (tropical and subtropical Atlantic), but differs in its narrower branches and the apices of the utricles, which are rounded to subacute rather than subtruncate.

C. pocockiae grows in pools and on more or less open rock at low tide level. At Cabo Inhaca it was found growing on the floor of a large pool in the low tide terrace in association with *C. acuminatum*, *C. lucasii* subsp. *capense*, *C. mozambiquense*, and *C. prostratum.*

It is a pleasure to name this species after Miss Pocock, in recognition of her extensive contributions to our knowledge of South African seaweeds and in appreciation of her unstinted co-operation during the course of this study.

14. **Codium tenue** (Kuetz.) Kuetzing, Tab. Phyc. 6: 33, pl. 95, fig. 1 (1856). J. Agardh 1887, p. 41 (excluding non-South African records). Delf and Michell 1921, p. 95 (Kowie, 4.v.1896, *H. Becker*, BOL; Hagahaga River Mouth, Cape Morgan, and Keimouth, *H. G. Flanagan*, BOL). Schmidt 1923, p. 50, fig. 34 (excluding non-South African records). Pocock 1955. Macnae 1957, pp. 124, 125, 131, and 363. [Fig. 15, Plate II, *b*]

C. tomentosum Stackh., ζ *tenue* Kuetzing, Sp. Alg. 501 (1849).

Records Under Incorrect Determinations.—Suhr 1834, p. 737, as *C.*

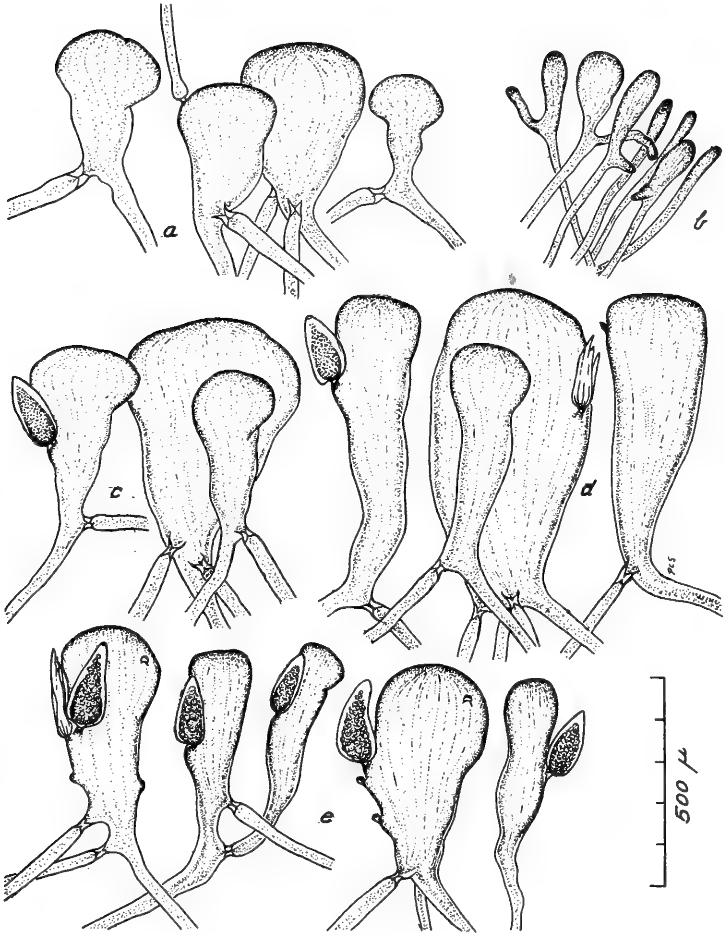


FIG. 15.—*C. tenue. a* ("Caput bonae spei," *Binder* = type), utricles from standard sample; *b, c, d* (Kowie River, C.P., *Pocock 10476*): *b*, utricles from tip of thallus; *c*, utricles from standard sample; *d*, utricles from base of thallus; *e* (Mouth of Zwartkops River, comm. *Pocock 10576*), utricles from standard sample.

tomentosum, pro parte ("Cap," *Zeyher*, S; Algoa Bay, *Zeyher*, S). Areschoug 1851, p. 6, as *C. tomentosum*, Suhr reference only, pro parte.

Excluded Records.—Barton 1893, p. 82=*C. extricatum* (Cape Agulhas, *Hohenacker*, Meeresalgen, No. 496, BM). Schmidt 1923, p. 50, Port

Natal (*Krauss*) record only=*C. capitatum* (B). Eyre, Broekhuysen, and Crichton 1938, p. 92=*C. extricatum* (East London, *Ecol. Surv. L.6*). Stephenson 1944, p. 300=*C. capitatum* (Umhlali, *Ecol. Surv. U.20.A*, etc.); p. 317=*C. extricatum* (Storms River, *Ecol. Surv. T.3.A*, etc.; p. 350=*C. capitatum* and *C. extricatum*. Stephenson 1947, pp. 283 and 296=*C. capitatum* and *C. extricatum*.

Thallus erect, bushy, light green, edges of younger branches translucent, to 45 cm. high, closely divaricately dichotomously branched (to 15 orders), interdichotomies terete, dichotomies flattened and expanded; infra-axillary dilations conspicuous in lower portion of thallus, to 2·2 cm. broad; interdichotomies 4—5 mm. diam. in lower portion of thallus, attenuated toward tips, which are 1—2 mm. diam. Thallus dissecting out into individual utricles; utricles just below tips turbinate, orbicular, obovate, or clavate, mostly 135—400 μ diam., 330—450 μ long; those in lower portion of thallus mostly of two forms: turbinate, quadrate, obovate, or pyriform, 400—700 μ diam., 600—800 μ long; and pyriform or clavate, 135—210 (—265) μ diam., 480—760 μ long; apices broadly rounded or slightly flattened; utricular wall 1·5 μ thick, at apices scarcely thickened (—2·5 μ). Hairs (or hair scars) frequently present, 1 (—3) per utricle, borne in zone 70—120 μ below apex. Medullary filaments mostly 20—40 (—50) μ diam., usually more than one emitting from base of each utricle. Gametangia ovoid or less often stoutly fusiform, 48—96 μ diam., 122—238 μ long, 1—2 (—3) per utricle, each borne on pedicel 7—12 μ long on slight protuberance 190—340 μ below apex (usually below middle of utricle).

Type.—"Ad Caput bonae spei. Specimen dedit cl. *Binder*" (Kützing), (L). Kützing cited the type locality as "Tafelbai," but this almost certainly is erroneous.

Known Range.—Cape Province: Knysna to Port St. Johns.

Representative Collections Examined.—CAPE PROVINCE. Knysna. 1894, *A. Weber-van Bosse* (L). Groot River Mouth, ii.1941, *Rhodes Univ. Coll. Exped.* (RU). Estuary of Zwartkops River, on small boulders and jetty piles at Amsterdam Hoek, 16.ii.1953, leg. W. Macnae, comm. *Pocock 10576*. Richmond (Boknes River lagoon), 30.viii.1942, *Pocock 6224*. Kariega River, on stones below causeway 10·5 mi. from sea, 16.ii.1943, *Pocock 6823*. Kowie River, 7.ix.1952, *Pocock 10476*. Kleinmond, lagoon, 13.v.1945, *Pocock 8392*. Cape Morgan, *H. G. Flanagan* (BOL). Port St. Johns (lighthouse rocks), 31.vii.1938, *Pocock & Papenfuss 354* (UC only); on *Padina* in high tide pool, 29.ix.1945, *Pocock 8815*,

The nature of this species has long been subject to much conjecture, even though the type specimen had been re-examined (by Schmidt and others). Consequently, the name has been applied to unrelated species

from various parts of the world, especially Australasia. In South Africa it has been applied to *C. capitatum* and slender forms of *C. extricatum.* With the extensive collections now at hand, it has been possible to arrive at a satisfactory definition of the species. *C. tenue* is very distinctive, both morphologically and ecologically. The light green colour, divaricately dichotomous branching, regular infra-axillary dilations, and attenuated tips are outstanding features. The type specimen is but a fragment, the distal portion, of a thallus. Anatomically the small turbinate or quadrate utricles of the tenuous distal portions of the thallus have been considered typical of *C. tenue*, but they increase greatly in size in the lower thicker portions of the thallus, where they are intermixed with a second type of utricle, one whose shape is pyriform or clavate.

C. tenue occupies a unique habitat, growing on silt-covered rocks and shells and on concrete or wood jetty piles in river mouths (estuaries and lagoons). Formerly it was known only from the distal attenuated portions found in drift, but now it has been found attached at several localities. In the Kariega River large bushy plants grow as far as 10·5 miles upstream from the sea, both above and below the causeway, which is near the tidal limit. Details of its occurrence in the Zwartkops Estuary are given by Pocock (1955) and Macnae (1957). The only recorded exception to the estuarine habitat is the case of plants collected at Second Beach, Port St. Johns, in a high tide pool, associated with *Padina commersonii.* This exception may be accounted for by the fact that the stream from the marsh above this part of the beach enters the sea through this pool.

15. **Codium cicatrix** sp. nov. [Fig. 16, Plate XII, *a*]

Previous Record.—Pocock 1958, p. 24, as *C. papillatum.*

Thallus erectus ad 19 cm. alt. divaricate dichotome ramosus (ad novies), ramis teretibus ad basim 4—5 mm. diam., ad apices ad 2 mm. diam. gradatim attenuatis. Thallus extrinsecus in utriculos singulos dissectus; utriculi cylindrici aut saepius clavati (145—) 235—390 μ diam., 630—920 μ long.; apices subtruncati, saepe paululum depressi; membrana utricularis 1·5 μ crass., ad apices vix ad paululum incrassata (—17 μ). Pili (aut pilorum cicatrices) frequentes, aliquot ad plures per utriculum, in zona admodum infra apicem (ab apice ad 120 μ infra) portati; pili saepe abortivi, excrescentias cellulosae similes ad pilorum cicatricibus, sed rotundatas formantes. Filamenta medullaria plerumque 21—56 μ diam. Gametangia subcylindrica aut ellipsoidea ad crasse fusiformia, 65—120 μ diam., (235—) 300—330 μ long., 2—4 per utriculum, omnia in pediculis tenuibus 5—7 μ long. in protuberatione parva 300—420 μ infra utriculi apicem portata.

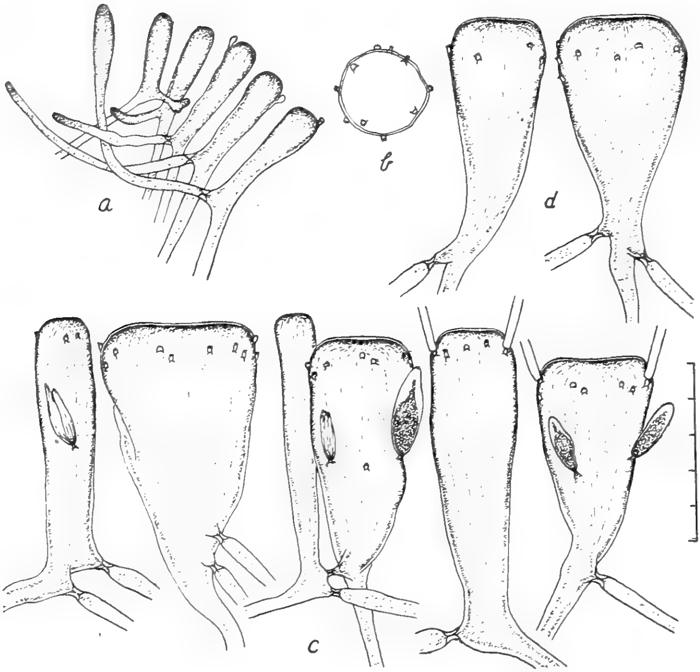


FIG. 16.—*C. cicatrix.* *a, b, c* (Ponta Rasa, Mozambique, comm. *Pocock 12279*= type): *a*, utricles from tip; *b*, top view of apex of utricle; *c*, utricles from standard sample; *d* (Barreira Vermelha, Mozambique, *Pocock 12264*), utricles from standard sample.

Thallus erect, to 19 cm. high, divaricately dichotomously branched (to 9 orders), branches terete, with translucent edges, 4—5 mm. diam. at base, tapering gradually to 2 mm. diam. at apices. Thallus dissecting out into individual utricles; utricles cylindrical or more usually clavate, (145—) 235—390μ diam., 630—920 μ long; apices subtruncate, often slightly depressed; utricular wall 1·5 μ thick, at apices very slightly to slightly thickened (—17 μ). Hairs (or hair scars) common, several to many per utricle, borne in zone immediately below apex (from apex to 120 μ below); hairs often abortive, forming cellulose outgrowths similar to hair scars, but rounded. Medullary filaments mostly 21—56 μ diam. Gametangia subcylindrical or ellipsoidal to stoutly fusiform, 65—120 μ diam., (235—) 300—330 μ long, 2—4 per utricle, each borne on slender pedicel 5—7 μ long on slight protuberance 300—420 μ below apex of utricle.

Type.—Sandbank covered with coral debris off Ponta Rasa, Inhaca Channel, Mozambique, on *Cymodocea ciliata*, 25.ix.1957, leg. W. Macnae, comm. *Pocock 12279* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Other Collections Examined.—MOZAMBIQUE. Delagoa Bay, viii.1935, *G. C. Nel.* Estação de Biologia Maritima, Ilha da Inhaca, on cement wall of sea-water intake, 11.xii.1955, *Pocock 11052* (MAP). Tidal flats between Estação and Ponta Punduini, Ilha da Inhaca, on *Cymodocea ciliata*, 12.xii.1955, *Pocock 11069.* Coral reef off Barreira Vermelha, drift, 25.ix.1957, *Pocock 12264.*

Anatomically the material referred to this species is very similar to *C. papillatum* Tseng and Gilbert (1942) from the Philippines. The most conspicuous feature is the abundance, just below the apex of the utricle, of hair "scars", some of which would appear to represent aborted primordia rather than scars. As in *C. papillatum*, these outgrowths cause the utricles to adhere to one another to the extent that in any sample one to several broken upper portions of utricles may be observed, giving a vertical view rather than the usual lateral view of the apex of the utricle. In habit, however, *C. cicatrix* is very different from *C. papillatum*, which is cervicorn with flattened segments.

16. **Codium extricatum,** sp. nov. [Fig. 17, Plates XIII and XIV]

Records Under Incorrect Determinations.—Suhr 1834, p. 737, as *C. tomentosum*, pro parte ("Cap," *Zeyher*, S). Areschoug 1851, p. 6, as *C. tomentosum*, Suhr reference only, pro parte. Barton 1893, p. 82, as *C. tenue* (Cape Agulhas, *Hohenacker*, Meeresalgen No. 496,* BM). Delf and Michell 1921, p. 95, as *C. tomentosum*, Cape Morgan record, pro parte ("seashore near Keimouth," 1892, *H. G. Flanagan*, BOL). Eyre, Broekhuysen, and Crichton 1938, p. 92, as *C. tenue* (East London, *Ecol. Surv. L.6*). Stephenson 1944, as *C. tenue*, p. 317; p. 350, pro parte; 1947, pp. 283 and 296, pro parte (Storms River, *Ecol. Surv. T.3.A*; etc.).

Thallus erectus ad 50 cm. alt. dichotome ramosus (octies ad quaterdecies), dichotomiis confertis aut distantibus, rami in parte thalli inferiore plerumque complanari solent, supra subteretes teretesve, ad basem ad 8 mm. latos, ad 1·5—2 mm. diam. ad apices gradatim attenuati. Thallus

*Plants distributed as No. 496 of R. F. Hohenacker's Algae marinae siccatae, Lieferung X (1862), under the name *C. tomentosum* var. *tenue* Kuetz., allegedly from Cape Agulhas, comprise a heterogeneous assortment of materials. Six species have been detected, as follows: *C. capitatum* (WU) [undoubtedly from Natal]; *C. isaacii* (PC) [probably from Table Bay]; *C. extricatum* (BM, M), and *C. fragile* subsp. *capense* (W, WU) [possibly from Cape Agulhas]; *C. tomentosum* (W) and *C. vermilara* (FI, L, M, NY, UC) [this material probably is the residue of that which was distributed as No. 59, "*C. tomentosum*", from Cherbourg, which is a mixture of *C. tomentosum* and *C. vermilara*].

extrinsecus in utriculos singulos dissectus; utriculi subcylindrici ad clavatos. (88—) 125—280 (—325) μ diam., 450—880 μ long., 2·5—4·5 (—6·5) plo longiores quam lati, apicibus truncatis, subtruncatis, depressis aut paululum rotundatis; membrana utricularis circa 2 μ crassa,

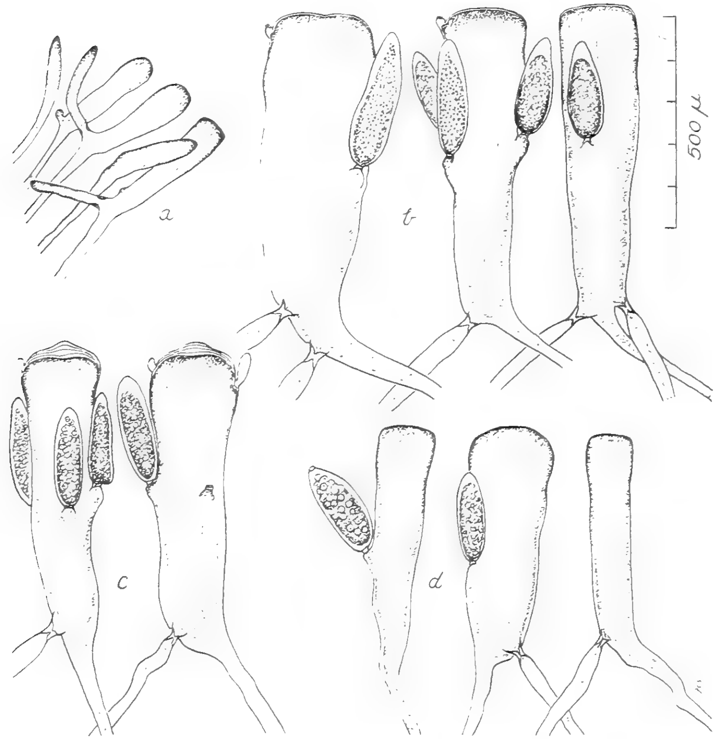
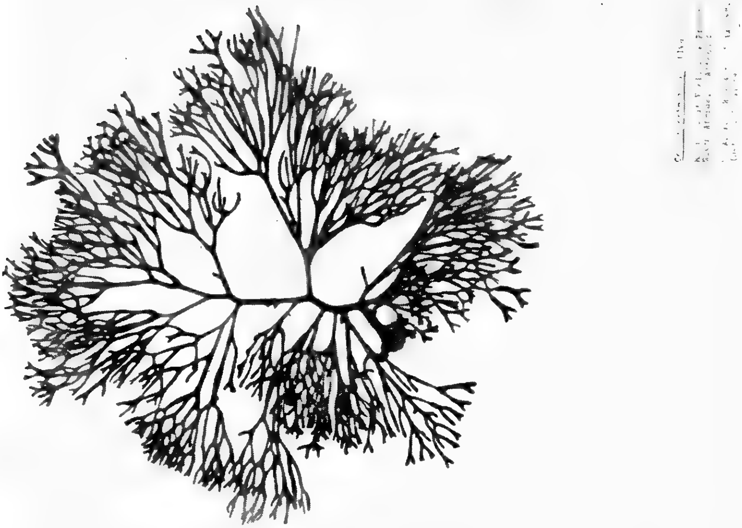


FIG. 17.—*C. extricatum.* *a*, *b* (Qolora, C.P., *Pocock 10546*=type): *a*, utricles from tip of thallus; *b*, utricles from standard sample; *c* (Struis Bay Beach, C.P., *Papenfuss 89*), utricles from standard sample; *d* (Kasouga, C.P., *Pocock 10588*), utricles from standard sample.

ad apicem vix (5—6 μ), modice (—15 μ) aut valde (—65 μ) incrassata, apicibus incrassatis conspicue lamellatis, interdum paululum introrse umbonatis. Pili (aut pilorum cicatrices) frequentes, unus ad aliquot per utriculum, in zona 40—100 μ infra apicem portati. Filamenta medullaria plerumque 20—40 μ diam. Gametangia lance-ovata, ellipsoidea aut



a

b

PLATE XIII. *Codium extricatum.*

a (Salt Vlei, Kowie, C.P., *Pocock 10472*): plant with congested, wholly terete branches; *b* (Qolora, C.P., *Pocock 10546*=holotype): upper dichotomies distant, lower dichotomies less distant and somewhat flattened.

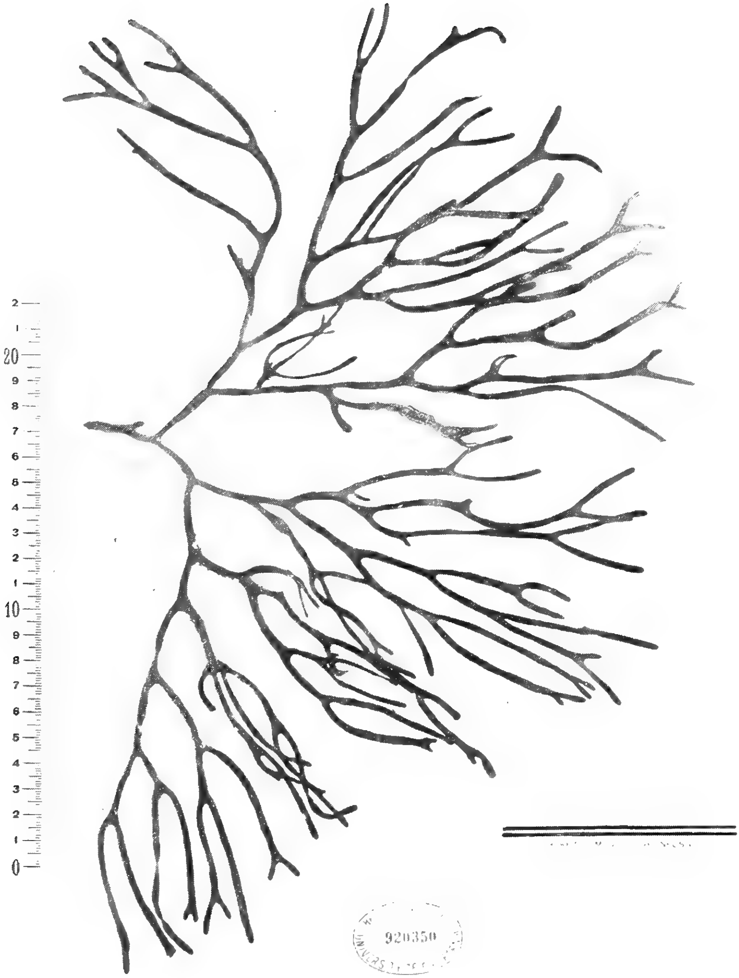


PLATE XIV. *Codium extricatum.*

(Struis Bay Beach, C.P., *Papenfuss 89.*) Plant cast up from sublittoral with close, wholly terete branches.

cylindrica 55—100 (—150) μ diam., 240—330 μ long., 1—3 per utriculum, omnia in pediculis circa 8—12 μ long. in protuberatione 270—410 μ infra utriculi apicem (prope utriculi mediam partem) portata.

Thallus erect, firm, very dark green, to 50 cm. high, dichotomously branched (8—14 orders), dichotomies close or distant, branches tending to be flattened in lower part of thallus, subterete or terete above, to 8 mm. broad at base, tapering gradually to 1·5—2 mm. diam. at apices. Thallus dissecting out into individual utricles; utricles subcylindrical to clavate, (88—) 125—280 (—325) μ diam., 450—880 μ long, 2·5—4·5 (—6·5) × long as broad, with truncate, subtruncate, depressed, or slightly rounded apices; utricular wall ca. 2 μ thick, at apex slightly (5—6 μ), moderately (—15 μ), or markedly (—65 μ) thickened, incrassate apices conspicuously lamellate, at times slightly introrsely umbonate. Hairs (or hair scars) common, one to few per utricle, borne in zone 40—100 μ below apex. Medullary filaments mostly 20—40 μ diam. Gametangia lance-ovoid, ellipsoidal, or cylindrical, 55—100 (—150) μ diam., 240—330 μ long, 1—3 per utricle, each borne on pedicel about 8—12 μ long on protuberance 270—410 μ below apex of utricle (near middle of utricle).

Type.—Mouth of Qolora River, Cape Province, 4.x.1952, *Pocock 10546* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Known Range.—Cape Agulhas, Cape Province, to Umpangazi, Natal.

Representative Collections Examined.—CAPE PROVINCE. Cape Agulhas, *Hohenacker*, Meeresalgen No. 496 (BM). Struis Bay Beach, cast ashore, 1.iii.1937, *Papenfuss 89.* Arniston, 20.ii.1939, *Pocock 525* (UC only). Groot River Mouth (Blue Rocks), 29.vi.1942, *Pocock 6438* (MAP). Storms River Mouth, 2.iv.1939, *Ecol. Surv. T.3.A.* Jeffreys Bay, 8.v.1927, *W. A. Setchell.* Reef Bay, near Port Elizabeth, 5.vii.1936, *Ecol. Surv. E.31.* Algoa Bay, 1837, *Zeyher* (HBG). Richmond, 24.iii.1939, *Ecol. Surv. Y.1.T.* Bushman's River Mouth, 1.vi.1942, *Pocock 6091.* Kariega Rocks, 19.ii.1943, *Pocock 6924.* Kasouga (Ship Rock), 1.iii.1953, *Pocock 10588.* Sharks Bay, 21.ix.1952, *Pocock 10503* (UC only). Cove Rock, 18.vii.1943, *Pocock 7361.* East London (Shelly Beach), 6.vii.1937, *Ecol. Surv. L.6.* Black Rock, just east of Hagahaga, i.1941, *Pocock 3679.* Morgan Bay, 5.x.1951, *Pocock 9454.* Keimouth, 22.vii.1937, *Papenfuss 369.* Bashee River Mouth, 27.ix.1939, *Pocock 1693.* NATAL. Port Shepstone, 27.ix.1953, *Pocock & Papenfuss 241.* Umhlali (Salt Rock Beach), 24.ix.1953, *Isaac B.486.* Umpangazi, 5.v.1939, *Ecol. Surv. G.6.B.*

C. extricatum shows considerable variation in size, in thickness, and degree of flattening of branches, and in size and degree of thickening of apical walls of utricles. It grows in somewhat sheltered deep tide pools and, more luxuriantly, on rocks in the open sea (exposed to full surf at Black Rock).

17. **Codium duthieae** Silva, Austral. Journ. Bot. 4: 275, fig. 10; pl. 1, fig. 2 (1956). The following South African references are under the name *C. duthieae* Setchell (or Setch. ex Papenfuss), a *nomen nudum:* Stephenson, Stephenson, and du Toit 1937, p. 372. Eyre and Stephenson 1938, p. 33 (Isipingo, *Ecol. Surv. D.36*). Eyre, Broekhuysen, and Crichton

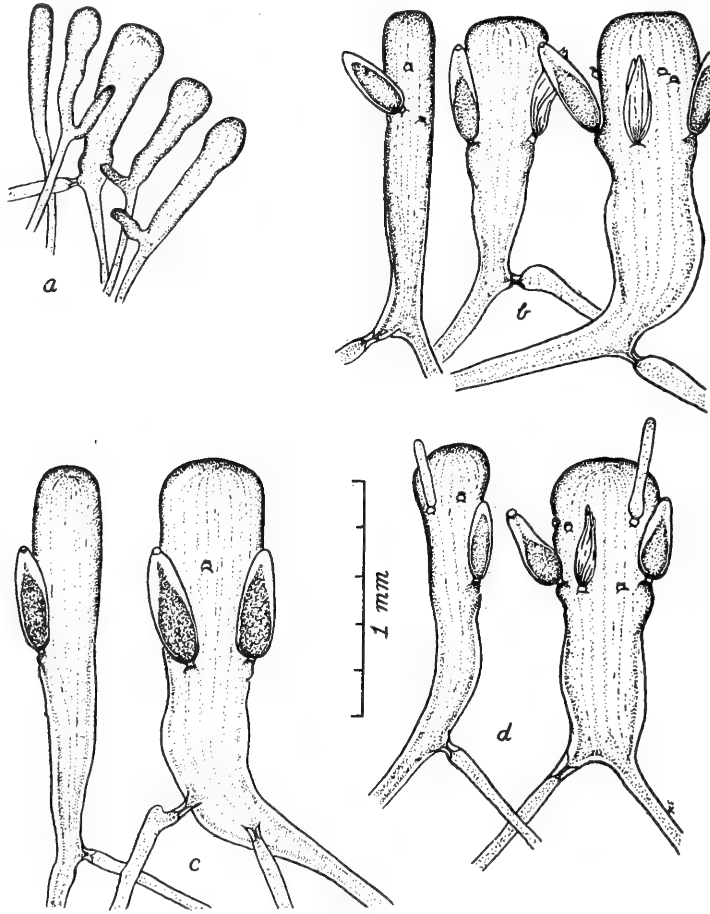


FIG. 18.—*C. duthieae*. *a*, *b* (Strandfontein, False Bay, C.P., *Papenfuss 24*): *a*, utricles from tip of thallus; *b*, utricles from standard sample; *c* (Kowie, C.P., *Pocock 10505*), utricles from standard sample; *d* (Isipingo, Natal, *Ecol. Surv. D.36*), utricles from standard sample.

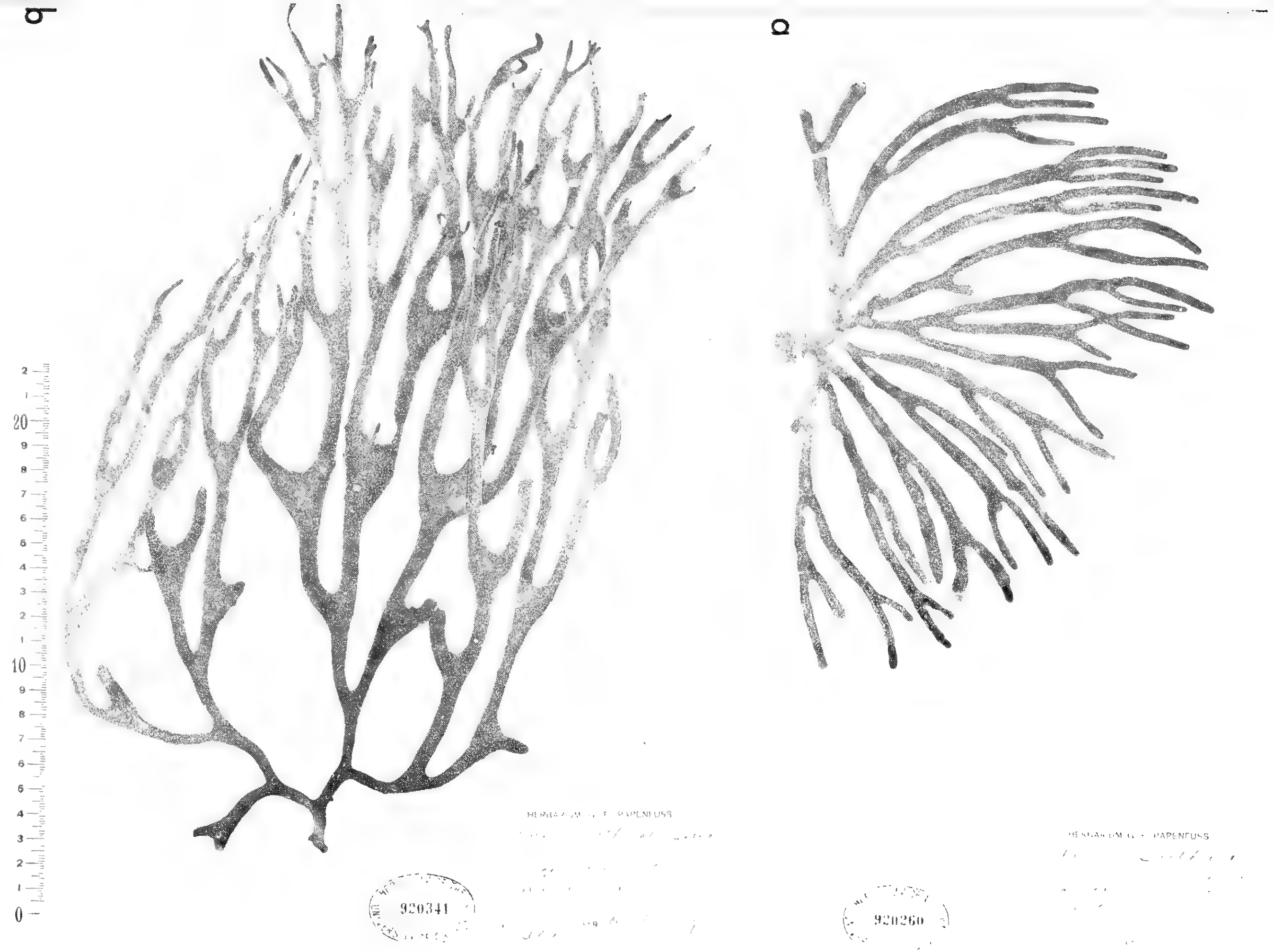


PLATE XV. *Codium duthieae.*

a (Strandfontein, False Bay, C.P., *Papenfuss 24*=holotype): plant with usual terete branches; *b* (Langebaan, C.P., *Papenfuss* [illegible]): plant

1938, p. 92 (East London, *Ecol. Surv. L.7*). Eyre 1939, p. 296. Pocock 1939, p. 78. Stephenson 1944, pp. 300 and 317; 336 (pro parte); 349 (pro parte). Stephenson 1947, pp. 283 and 296 (pro parte). [Fig. 18, Plate XV]

Records Under Incorrect Determinations.—Harvey 1838, p. 404, as *C. tomentosum*, pro parte ("C. b. sp.," *W. H. Harvey*, K). Barton 1893, p. 82, as *C. tomentosum*, pro parte ("Pr. b. sp.," *Gueinzius*, BM; Keimouth, 1892, *H. G. Flanagan*, BM). Barton 1896, p. 194, as *C. lindenbergii*, Port Elizabeth record only (1893, *Farquhar 4*, BM). Delf 1921, pp. 58 and 62, as *C. tomentosum*, pro parte (see "Unverified Records"). Delf and Michell 1921, p. 95, as *C. tomentosum*, Bomvanaland Coast (vi.1897, *Mrs. Filmer*, BOL) and Cape Morgan ("seashore near Keimouth," 1892, *H. G. Flanagan*, BOL, pro parte) records only.

Excluded Record.—Stephenson, Stephenson, and Day 1940, p. 355= *C. isaacii* (identity inferred from locality).

Thallus erect, to 60 cm. high, dichotomously branched; branches wholly terete, flattened only at dichotomies, or flattened almost throughout; interdichotomies 3—14 mm. broad, dichotomies to 40 mm. broad. Thallus dissecting out into individual utricles; utricles cylindrical to clavate, noticeably variable in diameter in any one sample, (130—) 176—500 (—720) μ diam., 800—1,800 μ long; apices broadly rounded or subtruncate; utricular wall 2 μ thick at base of utricle, gradually thickening toward apex, usually 6—10 μ thick at apex, occasionally moderately to markedly thickened (—42 μ). Hairs (or hair scars) occasional, at times fairly numerous (to 12 per utricle), borne in zone 185—430 μ below apex of utricle. Medullary filaments mostly 43—72 μ diam. Gametangia lance-ovoid, 70—180 μ diam., (235—) 270—430 (—500) μ long, several (—8) per utricle, each borne on pedicel about 15 μ long on protuberance 345—675 μ below apex of utricle.

Type.—Strandfontein, False Bay, Cape Province, 13.xi.1935, *Papenfuss 24* (UC; isotype in BOL).

Known Range.—Saldanha Bay; Table Bay, Cape Province, around the Cape of Good Hope to the mouth of the Limpopo River, Mozambique. Australia.

Representative South African Collections Examined.—CAPE PROVINCE. Langebaan, 3.iii.1938, *Papenfuss 257*. Camps Bay, 1.ix.1936, *Papenfuss 26*. False Bay: Kalk Bay, 20.vii.1936, *Papenfuss 19*; Strandfontein, 24.xi.1936, *Papenfuss 363*; Somerset Strand, 23.iv.1935, *A. V. Duthie*. Cape Agulhas, 28.ix.1939, *Ecol. Surv. AG.5.C*. Struis Bay Beach, cast ashore, 1.iii.1937, *Papenfuss 91*. Arniston, 23.xi.1939, *Ecol. Surv. AR.1.B*, *A.R.1.C*. White Sands, *M. E. Rademan*. Still Bay, ix.1934, *C. J. van der Merwe*. Little Brak River Mouth, vi.1939, *T. F. Gericke*.

Buffalo Bay, 29.i.1944, *Pocock 7879.* Knysna, 1842, *F. Krauss* (FI). Plettenberg Bay, 29.vi.1937, *Papenfuss 364.* Storms River Mouth, 25.i.1940, *Ecol. Surv. TT.7.B.* Jeffreys Bay, 28.iii.1939, *Ecol. Surv., Z.2.C.* Port Elizabeth, 30.vi.1937, *Papenfuss 360.* Bushman's River Mouth, vii.1937, *P. M. de Vos.* Kariega Rocks, 19.ii.1943, *Pocock 6923.* Kasouga (Ship Rock), 1.iii.1953, *Pocock 10586.* Kowie (Sharks Bay), 21.ix.1952, *Pocock 10609.* Port Alfred, iii.1870, *H. Becker* (BOL). Kleinmond, 19.iii.1939, *Ecol. Surv. X.1.D.* Waterloo Bay, 3.iv.1942, *Pocock 4960.* East London, 7.vii.1937, *Ecol. Surv. L.7.* Bonza Bay, 27.vii.1937, *Papenfuss 361.* Keimouth, 22.vii.1937, *Papenfuss 169.* Qolora, 4.x.1952, *Pocock 10553.* Dwessa, iv.1938, *Rayment 218.* Port St. Johns, 28.vii.1938, *Pocock & Papenfuss 243.* NATAL. Port Shepstone, 27.vii.1938, *Pocock & Papenfuss 242.* Umtwalumi River Mouth, 25.xii.1938, *Ecol. Surv. M.1.B.* Isipingo, 3.vii.1935, *Ecol. Surv. D.36.* Umhlali (Salt Rock Beach), 24.ix.1953, *Isaac B. 488.* Umpangazi, 2.v.1939, *Ecol. Surv. G.2.A.* St. Lucia Rocks (Crayfish Point), 21.vii.1938, *Pocock & Papenfuss 234.* MOZAMBIQUE. Vila de João Belo, near mouth of Limpopo River, viii.1936, *G. C. Nel.*

C. duthieae was picked up by many of the earlier collectors, but it was not distinguished from *C. tomentosum.* Setchell recognized it as a distinct species and annotated herbarium sheets *C. duthieae*, commemorating Dr. A. V. Duthie, who had sent him many collections of this, as well as other, species of *Codium.* This name remained a *nomen nudum* until 1956.

C. duthieae exhibits a wide range of variability in both habit and anatomy which parallels that found in its close relative, *C. decorticatum* (Woodw.) Howe. A statistical analysis of this variation pattern would be desirable, but even in the absence of such a study, certain observations seem warranted. There is a tendency for the dichotomies to be flattened, especially in plants growing in protected localities. Thus, specimens from Saldanha Bay and False Bay are markedly flattened and expanded. The juxtaposition in several localities of loose-textured plants with enormous utricles and relatively firm plants with smaller utricles would seem to indicate that differences in the size of utricles are not due to environmental differences. I suspect that age difference is more important than genic difference as a factor in this variability, although no supporting evidence is available at this time. Occasionally, plants with unusually small utricles are encountered, but these can be recognized in that the proportions and details characteristic of normal-sized utricles are retained. Plants along the Natal coast generally have utricles which are stouter and with more rounded apices than those farther west.

C. duthieae grows usually in the deeper pools of the sublittoral fringe

and lower littoral zone, occasionally in open shallow bays (as at Salt Vlei Bay).

18. **Codium isaacii** sp. nov. [Fig. 19, Plate XVI, *b*]

C. tomentosum var. *capense* J. E. Areschoug, Nova Acta Reg. Soc. Sc. Upsal. III, 1: 368 (1854). "Ad Caput bonae spei, frequentissime."

Records Under Incorrect Determinations.—Harvey 1838, p. 404, as *C. tomentosum*, pro parte ("C. b. sp.," *Harvey*, AG). Drège 1843, pp. 109 and 111, as *C. tomentosum*, pro parte (see "Unverified Records"). Areschoug 1851, p. 6, as *C. tomentosum*, Drège reference only, pro parte. Stephenson, Stephenson, and Day 1940, p. 355, as *C. duthieae* (identity inferred from locality). Stephenson 1944, pp. 336 and 349, as *C. duthieae*, pro parte (Paternoster, *Ecol. Surv. P.4.D*). Stephenson 1947, pp. 283

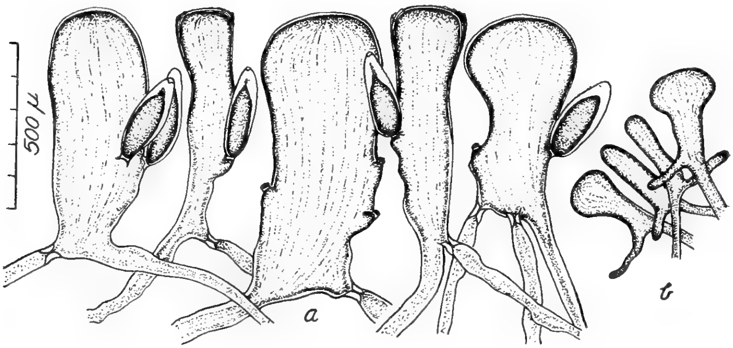


Fig. 19.—*C. isaacii* (Melkbosch, C.P., *Papenfuss 358*=type). *a*, utricles from standard sample; *b*, utricles from tip of thallus.

and 296, as *C. duthieae*, pro parte. Silva and Womersley 1956, fig. 10*d*, as *C. duthieae*.

Thallus erectus ad 20 cm. alt., dichotome ramosus (ad octies), interdum subfastigiatus; rami teretes, ad basim 6 mm. diam., prope apicem ad 2·5—3 mm. attenuati. Thallus extrinsecus in utriculos singulos dissectus; utriculi subcylindrici ad clavatos aut pyriformes, crassi, 185—400 (—590) µ diam., 500—900 (—1,050) µ long., 1·3—3 (—3·5) plo longiores quam lati, apicibus rotundatis; membrana utricularis ad basim utriculi 2 µ crass., ad apicem gradatim incrassata; apex modice (—30 µ) ad valde (—70 µ) incrassatus, manifeste lamellatus, per strata exteriora rupta atque desquamata asperatus. Pili aut pilorum cicatrices non observati. Filamenta medullaria plerumque 35—75 µ diam., 2—4 e basi utriculorum vetustiorum emissa. Gametangia ellipsoidea aut crasse fusiformia aut

lanceo-ovata, 78—150 μ diam., 260—365 μ long., aliquot per utriculum, omnia in pediculis 8—14 μ long., in protuberatione conspicua 390—615 μ infra apicem (triente utriculi inferiore) portata.

Thallus erect, to 20 cm. high, dichotomously branched (to 8 orders), at times subfastigiate; branches terete, 6 mm. diam. at base, tapering to 2·5—3 mm. diam. at apices. Thallus dissecting out into individual utricles; utricles subcylindrical to clavate or pyriform, stout, 185—400 (—590) μ diam., 500—900 (—1,050) μ long, 1·3—3 (—3·5) x long as broad, with rounded apices; utricular wall 2 μ thick at base of utricle, gradually thickening toward apex; apex moderately (—30 μ) to markedly (—70 μ) thickened, conspicuously lamellate, roughened by rupturing and sloughing of outer layers. Hairs or hair scars not observed. Medullary filaments mostly 35—75 μ diam., usually 2—4 emitting from base of older utricles. Gametangia ellipsoidal, stoutly fusiform, or lance-ovoid, 7 8—150 μ diam., 260—365 μ long, several per utricle, each borne on pedicel 8—14 μ long on conspicuous protuberance 390—615 μ below apex (lower third of utricle).

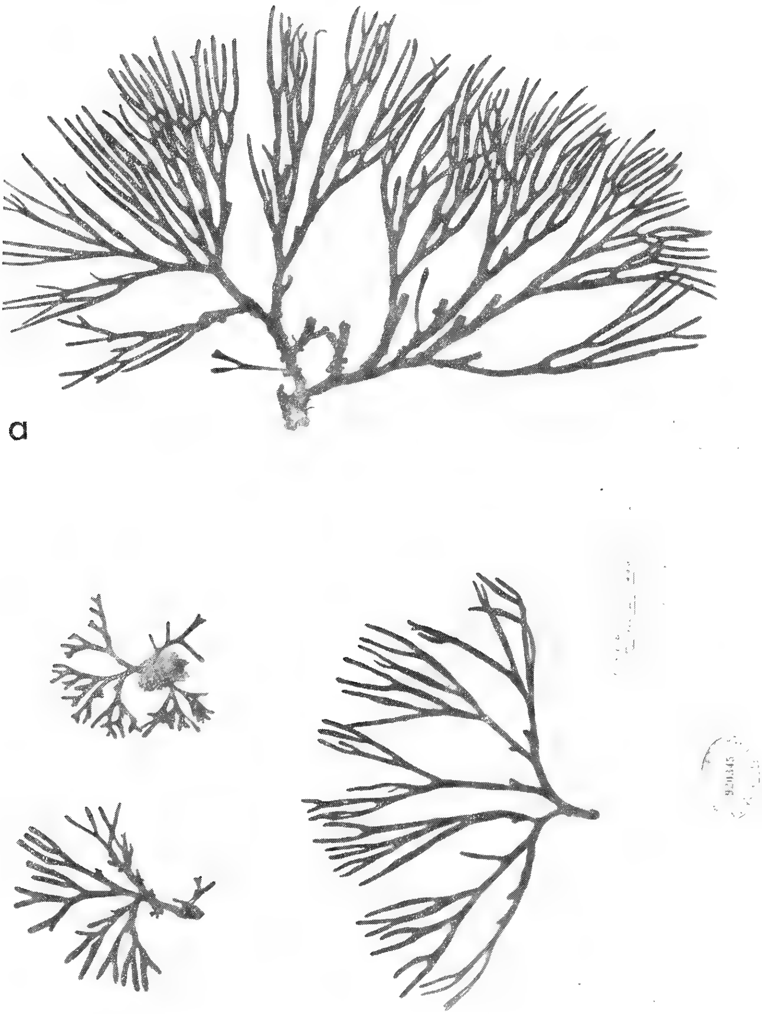
Type.—Melkbosch, Cape Province, 28.ix.1935, *Papenfuss 358* (UC).

Known Range.—Lüderitz, South West Africa, to Table Bay, Cape Province.

Representative Collections Examined.—SOUTH WEST AFRICA. Lüderitz, 26.vii.1957, *Isaac I.1111.* SOUTH AFRICA. CAPE PROVINCE. Port Nolloth, 4.x.1947, *Rodin 1505.* Paternoster, 3.i.1938, *Papenfuss 253*; 19.ii.1939, *Ecol. Surv. P.4.D.* Melkbosch, 27.i.1937, *Papenfuss 13.* Table Bay, *Pappe 68* (AG).

This species, though anatomically definable, is not especially distinctive. From considerations of the general shape of the utricles and of the size, shape, number, and position of the gametangia, one would be led to assign this material to *C. duthieae* as a form with small utricles. Careful study has revealed several significant differences, however, which are consistent throughout the range. The utricles are smaller and stouter; the position of the gametangia relative to the apex of the utricle being the same in both species, the shorter utricles of *C. isaacii* cause the gametangia to be borne strikingly lower. Hairs apparently are absent. The utricular wall thickens noticeably from the base upward, so that the upper third of the utricle (and especially the apex) is usually conspicuously thickened and lamellate. During development of this thickening, the outer layers rupture and slough off from the apex, which thus remains rough and with jagged edges along its shoulders.

C. isaacii appears to be the only strictly cold-water species of *Codium* in South Africa. Although it shares its territory with *C. fragile* subsp. *capense*, the latter ranges eastward into somewhat warmer waters as far



a

b

Plate XVI.

a, *Codium fragile* subsp. *capense* (Melkbosch, C.P., *Papenfuss 12*=holotype); *b*, *Codium isaacii* (Melkbosch, C.P., *Papenfuss 358*=holotype).

as Robberg. At Saldanha Bay, an insolated area, *C. duthieae*, a species of warmer waters, intrudes into the range of *C. isaacii*.

Various herbaria contain specimens annotated "*Codium tomentosum*" or "*Codium tomentosum* var. *capense*" which probably, although not positively, were seen by Areschoug before he described this variety. These include representatives of *C. extricatum* ("Cap," *Zeyher*, S), *C. tenue* (Algoa Bay, *Zeyher*, S), *C. capitatum* (Port Natal, *Krauss*, AG), *C. isaacii* ("in sinu tabulari vulgare," *Pappe 68*, AG), *C. duthieae* (Table Bay, *Pappe*, S), and *C. fragile* subsp. *capense* ("Cap. b. spei," *Herb. Aresch.*, PC). In the absence of figures and explicit annotations on herbarium sheets, Areschoug's description is our only guide to the selection of a lectotype, and unfortunately it is not sufficiently diagnostic to remove all doubt. Only three species fit his statement that upon drying the thallus becomes verruculose: *C. duthieae*, *C. isaacii*, and *C. fragile*, of which *C. duthieae* is most conspicuously verruculose. The size of the utricles specified by Areschoug (>200 μ diam., 800 μ long), however, points more to *C. isaacii* and *C. fragile*. Areschoug stated that the utricular wall is far thicker than in "typical *C. tomentosum*," but did not mention mucronate apices. Hence, *C. isaacii* would seem to be the species to which the description best applies, and as lectotype I select the Pappe specimen from Table Bay in Herb. Agardh. (No. 15561).

In naming this species after Professor Isaac, I welcome the opportunity to commemorate his notable contributions to our knowledge of the distribution of South African seaweeds and to express appreciation for his kind help in the carrying out of this study and in the publication of the manuscript.

19. **Codium fragile** (Sur.) Har. subsp. **capense** subsp. nov. [Figs. 20 and 21, Plate XVI *a*]

Previous South African Records.—Rudolphi 1831, p. 179, as *C. tomentosum* (see "Unverified Records"). Suhr 1834, p. 737, as *C. tomentosum*, "Cap" record only, pro parte (Capetown, *Ecklon*, S). Harvey 1838, p. 404, as *C. tomentosum*, pro parte (Sea Point, *W. H. Harvey*, TCD). Drège 1843, pp. 107 and 111, as *C. tomentosum*, pro parte (see "Unverified Records"). Krauss 1846, p. 214, as *C. tomentosum*, Table Bay record only ("Cap d. g. Hoffnung," *Krauss*, HBG). Areschoug 1851, p. 6, as *C. tomentosum*, Rudolphi reference; Drège reference, pro parte; and Krauss reference, pro parte. Barton 1893, p. 82, as *C. tomentosum*, pro parte (St. James, False Bay, *C. G. Reynolds*, BM; "C. b. spei, 1774," *Brand*, BM); as *C. lindenbergii* (Cape of Good Hope, 1884, *Herb. Dickie*, BM). Barton 1896, p. 194, as *C. mucronatum*. Reinbold 1908, p. 187, as *C. mucronatum*. Delf 1921, pp. 58 and 62, as *C. tomentosum*, pro parte

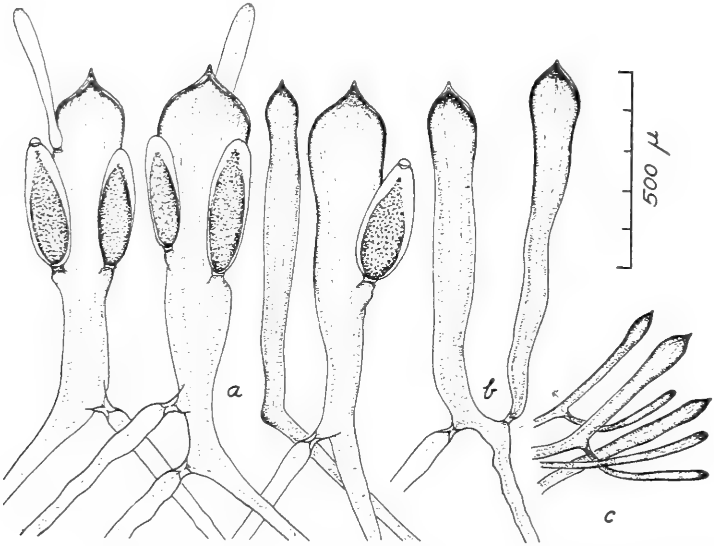


FIG. 20.—*C. fragile* subsp. *capense* (Danger Point, C.P., *Ecol. Surv. DP.1.A*) *a*, utricles from standard sample; *b*, utricles from lower part of thallus; *c*, utricles from tip of thallus.

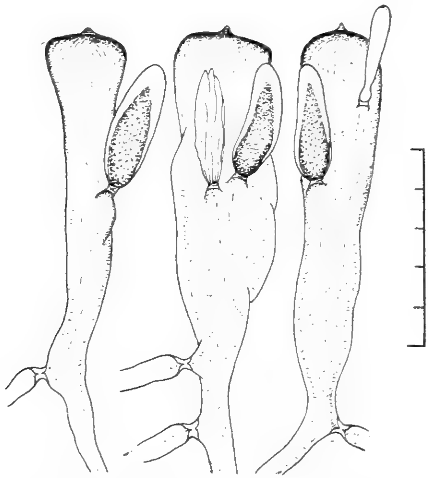


FIG. 21.—*C. fragile* subsp. *capense* (Melkbosch, C.P., *Papenfuss 12*=type). Utricles from standard sample.

(see "Unverified Records"). The following records are as *C. fragile*: Schmidt 1923, p. 47, Table Bay (*Krauss*, HBG) record only. Isaac 1937*b*, pp. 130, 133, 141, and 142. Bright 1938, pp. 77 and 78. Eyre 1939, p. 296. Pocock 1939, p. 78. Stephenson, Stephenson, and Day 1940, pp. 355 and 366. Isaac 1942, p. 234. Stephenson 1944, pp. 336 and 349. Isaac 1949, pp. 132 and 141. Stephenson 1947, pp. 283 and 296.

Excluded Records.—Schmidt 1923, p. 47, as *C. fragile*, Natal record only (Isipingo, 1894, *A. Weber-van Bosse*, NY); Silva 1951, p. 96. The material upon which these records are based is referable to *C. fragile* subsp. *capense*, but undoubtedly was not collected at Isipingo.

Thallus e frondibus erectis dichotomo-fastigiate ramosis 10—30 cm. alt., substrato per discum basalem latum spongiosum affixus, constat; rami omnino teretes aut in parte thalli inferiore paululum complanati, ad basim 5—8 (—14) mm. lat., prope apicem ad 3 mm. attenuati, atrovirides, raro proliferi. Thallus extrinsecus in utriculos singulos dissectus; utriculi clavati, (80—) 130—270 (—355) μ diam., 730—1,100 μ long., plurimum 3—6 plo longiores quam lati; apices acuminati; membrana utricularis 1·5—2 μ crass., ad apicem incrassata, acumine in mucronem acutum ad 60 μ long. producto; mucro partes interiores habens, lamellatus, interdum striationes concentricas praebens, adultus obtusus saepe factus. Pili crassi, sursum gradatim expansi; cicatrices pilorum frequentes, plerumque 1 vel 2 (—3) per utriculum, in zona 160—235 μ infra apicem portati. Filamenta medullaria plurimum 26—46 μ diam. Gametangia lanceo-ovata aut ellipsoidea aut cylindrica, 70—130 μ diam., 275—460 μ long., 1—3 per utriculum, omnia in pediculis 10—28 μ long. in protuberatione 430—630 μ infra utriculi apicem portata.

Thallus bushy, firm, very dark green, comprising one to several erect, dichotomo-fastigiately branched fronds 10—30 cm. high, attached to substratum by broad, spongy, basal disk; branches terete throughout or slightly flattened in lower part of thallus, 5—8 (—14) mm. broad at base, tapering to 3 mm. at apices, dark green, at times proliferous. Thallus dissecting out into individual utricles; utricles clavate, (80—) 130—270 (—355) μ diam., 730—1,100 μ long, mostly 3—6 x long as broad; apices pointed; utricular wall 1·5—2 μ thick, at apex thickened and prolonging point into sharp mucro to 60 μ long; mucro chambered, lamellate, sometimes with concentric striations, often becoming blunt with age. Hairs stout, gradually expanding upward; hair scars common, usually 1—2 (—3) per utricle, borne in zone 160—235 μ below apex. Medullary filaments mostly 26—46 μ diam. Gametangia lance-ovoid, ellipsoidal, or cylindrical, 70—130 μ diam., 275—460 μ long, 1—3 per utricle, each borne on pedicel 10—28 μ long on protuberance 430—630 μ below apex of utricle.

Type.—Melkbosch, Cape Province, 27.i.1937, *Papenfuss 12* (UC; isotypes in AD, BM, BOL, L, MAP, SAP).

Known Range.—Swakopmund, South West Africa, around the Cape of Good Hope to Robberg, Cape Province.

Representative Collections Examined.—SOUTH WEST AFRICA. Swakopmund, 31.x.1947, *Rodin 2172.* Lüderitz, 26.vii.1957, *Isaac B.502* (WEI). SOUTH AFRICA. CAPE PROVINCE. Port Nolloth, 4.x.1947, *Rodin 1505b.* Buffels River Mouth, 22.ii.1940, *Ecol. Surv. BR.1.D* Hondeklip Bay, 8.ii.1940, *Ecol. Surv. HB.3.A.* Groen River Mouth. 7.iii.1940, *Ecol. Surv. GR.3.A.* Zout River Mouth, 19.iv.1940, *Ecol. Surv, ZR.2.A.* Lamberts Bay, 5.i.1938, *Papenfuss 381.* Steenbergs Cove. 22.ii.1939, *Ecol. Surv. C.4.A.* Paternoster, 10.ii.1939, *Ecol. Surv. P.5.E.* Hoedjes Point, 2.i.1938, *Papenfuss 377.* Langebaan, 3.iii.1938, *Papenfuss 256.* Yzerfontein, 5.iv.1940, *Ecol. Surv. YZ.1.A.* Melkbosch, 28.ix.1935, *Papenfuss 379.* Blaauwberg, 27.iv.1939, *Pocock 1075.* Mouille Point, 18.v.1938, *Papenfuss 378.* Three Anchor Bay, 20.x.1935, *Papenfuss 25.* Sea Point, 18.v.1927, *W. A. Setchell.* Hout Bay, 3.vi.1939, *Pocock 1461.* Kommetje, 13.x.1935, *Papenfuss 380.* False Bay: St. James, 6.xi.1935, *Papenfuss 390*; Muizenberg, iv.1930, *Purcell 30* (K); Strandfontein, 24.xi.1936, *Papenfuss 22*; Somerset Strand, x.1937, *J. H. Stander*; Steenbras River Mouth, iv.1937, *T. F. de Waal.* Cape Hangklip, 8.i.1940, *Ecol. Surv. CH.1.R, CH.3.R.* Gans Bay, i.1946, *Isaac I.463,* Danger Point, 5.vii.1939, *Ecol. Surv. DP.1.A.* Cape Agulhas, 25.ii.1937, *Papenfuss 87.* Arniston, 20.ii.1939, *Pocock 529.* Robberg, 4.vi.1939, *Ecol. Surv. RR.1.J.*

The South African populations of *C. fragile* exhibit sufficient anatomical uniformity and distinctness to be set apart as a subspecies. The apices of utricles are broadly rounded, at times suggesting a German helmet. Although it is premature to discuss infraspecific relationships in *C. fragile*, subsp. *capense* would seem to be more closely related to subsp. *tomentosoides* (Europe, originally from Japan ?) than to those subspecies which inhabit other Southern Hemisphere regions (Australia, New Zealand, Patagonia).

C. fragile was picked up by many of the earlier collectors in South Africa, but was not distinguished from *C. tomentosum.* The first recognizable reference to it is Harvey (1838, p. 404): "The apices of the filaments of its periphery are sometimes mucronate, which no one appears to have noticed." It is interesting to note that in Herb. Kew. there is a specimen with the following data: "Cap de Bonne Espérance. ex Herb. Berk. 6/89. *Codium acuminatum* Crouan in herb. Les filaments qui composent la fronde sont tous acuminés au sommet; au lieu d'être arrondis comme dans le *Codium dichotomum.*"

In South Africa *C. fragile* grows in pools and channels of the lower littoral zone and sublittoral fringe. It is reported also from the lower part of the Granularis (Balanoid) zone of Lamberts Bay (Stephenson, Stephenson, and Day). It is not known with certainty from the region between Arniston and Robberg.

EXCLUDED SPECIES

In addition to the various species which have been erroneously attributed to South Africa on the basis of incorrect identifications, and which are cited in the treatment of the proper species, the South African record of the following species probably is based on erroneous labelling:

Codium galeatum J. Agardh, Lunds Univ. Årsskr. 23 (Afd. 3, Nr 2): 42, pl. 1, fig. 1 (1887). Reinbold 1908, p. 188.

Collections Allegedly from South Africa.—CAPE PROVINCE. Knysna, 1894, *A. Weber-von Bosse* (L). "Cap," *Herb. Reinbold.* (HBG).

I had dismissed the Reinbold report as an error attributable to interchange of labels (material from Australia and South Africa having been studied simultaneously) until the discovery (in 1950) in the Rijksherbarium, Leiden, of *C. galeatum* intermixed with *C. fragile* in a packet assertedly collected by Mme. Weber-van Bosse at Knysna in 1894. The question whether this distinctive Australian species also occurs in South Africa was thus re-opened, but after an intensive study of *C. fragile* from both South Africa and Australia, it is possible to say with certainty that the Weber-van Bosse packet contains material collected in Australia rather than in South Africa, and more precisely that probably it was collected in the Melbourne region.

UNVERIFIED RECORDS

The specimens upon which the following records are based have not been located with certainty:

Rudolphi 1831, p. 179, *Codium tomentosum*, "Van Camps-bai. Juli," *Ecklon.* Although no Ecklon specimen from Camps Bay has been located, one allegedly from Cape Town, referable to *C. fragile* subsp. *capense,* is housed at Stockholm. The description, "fronde dichotoma fastigiata cylindrica," strongly suggests that species.

Drège 1843, p. 107, *Codium tomentosum,* "Strandfontein, bei der Mündung der Olifantrivier, November"; p. 111, *C. tomentosum,* "Tafelbaai, bei der Stadt und auf Paardeneiland, Mai, Juni." Three specimens have been found, any of which might have been collected at the specified

localities: "Cap de bonne espérance, 1839," *Drège* (L)=*C. isaacii:* "Port Natal et S. Afr., reçu 1838," *Drège* (G)=*C. fragile* subsp. *capense*; "leg. *Drège*" (HBG)=*C. fragile* subsp. *capense.* Another Drège specimen at Genève, labelled "Kaffernküste," is referable to *C. duthieae.*

Barton 1893, p. 82, *Codium tomentosum,* Table Bay, *L. Boodle,* and Cape of Good Hope, 1884, *Herb. Dickie.* Both specimens are in the British Museum and were determined by me as *C. duthieae* in 1950, but recent studies have opened the possibility that they might be referable to *C. isaacii.* Unfortunately, they have been misplaced and thus are not available for restudy.

Barton 1893, p. 82, *Codium tomentosum,* Sea Point, *L. Boodle* [almost certainly either *C. duthieae* or *C. fragile* subsp. *capense*]. Barton 1896, p. 193, *Codium bursa,* Natal, *M. Evans* [probably either *C. megalophysum* or *C. papenfussii*]. Both of these references are based on specimens presumably housed in the British Museum, although they have not yet been located.

Reinbold 1908, p. 188, *Codium tomentosum,* "Kap d. g. H." The specimens upon which this record is based presumably were at Berlin and were destroyed in 1943.

Delf 1921, pp. 58 and 62, *Codium tomentosum,* "west coast of the Cape Peninsula." Almost certainly either *C. duthieae* or *C. fragile* subsp. *capense* or both.

Delf and Michell 1921, p. 95, *Codium tomentosum,* Algoa Bay and Knysna; *Codium lindenbergii,* Cape Morgan.

PHYTOGEOGRAPHIC RELATIONSHIPS

The *Codium* flora of South Africa shows a remarkably high degree of endemism. Of the sixteen species found along the shores of the Union (that is, excluding the three species treated in this paper which occur in Mozambique but not in the Union and which range an unknown distance northward along the east coast of Africa), eleven are known only from the Union while one [*C. isaacii*] occurs also in adjacent South West Africa. With reference to their centre of distribution (cf. Fig. 22), these endemic species may be listed as follows, from west to east: *C. isaacii, C. stephensiae, C. incognitum, C. papenfussii, C. platylobium, C. pelliculare, C. tenue, C. extricatum, C. megalophysum, C. prostratum, C. capitatum,* and *C. pocockiae.* All of the remaining species occur also in Australia: *C. lucasii, C. fragile, C. duthieae,* and *C. spongiosum.* Of these non-endemic species, *C. lucasii* and *C. fragile* are sufficiently distinct in South Africa to warrant subspecific recognition. *C. spongiosum* is Indo-Pacific in affinity, whereas the *C. fragile* complex is widely distributed, being pan-temperate, bipolar, as well as antarctic circumpolar.

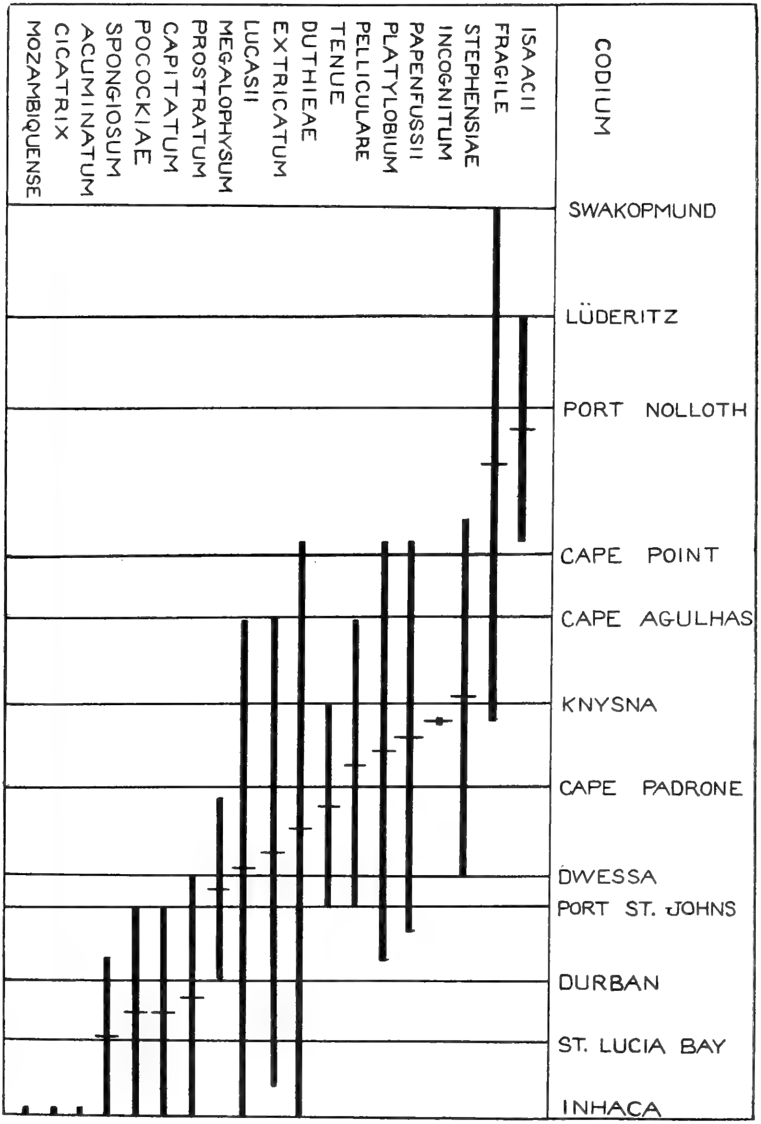


FIG. 22.—Graphic representation of the geographic ranges of the various species of *Codium* in southern Africa. Species are arranged according to their centre of distribution.

In examining the known ranges of the various species, one is immediately impressed by the correlation of range limits with three areas: Kommetje—Cape Town, Cape Agulhas, and Dwessa—Port St. Johns. Isaac (1937*a*, 1938) has ably discussed the hydrography of South Africa and the relationship of its features to the distribution of seaweeds. While there is no need to review the subject in its entirety, it may be worthwhile briefly to consider hydrography as an explanation of the effect of these three areas in limiting the ranges of various species of *Codium*.

On the east coast, the South Equatorial Current, flowing westward as part of the general anticyclonic circulation in the southern Indian Ocean, is divided into two branches by the intervention of Madagascar. The northern branch flows around the north end of that island and, in the region of Cabo Delgado on the east coast of Africa, again splits, one branch flowing northward and the other, the Mozambique Current, flowing southward close to the coast of Africa. In the region of Delagoa Bay, the Mozambique Current is joined by part of that branch of the South Equatorial Current which earlier was deflected to the southwest by Madagascar. The confluence of the two currents forms the swift-flowing warm Agulhas Stream, which continues close to the coast as far as Knysna Heads, where it is deflected slightly seaward by the Agulhas Bank, upon which it impinges. From the longitude of Knysna Heads westward the Agulhas Bank becomes broader, first gradually, then markedly, extending over 100 miles seaward south-east of Cape Agulhas. Accordingly, the greater part of the Agulhas Stream is deflected first to the south, then to the south-east, after which it returns to the circulation of the Indian Ocean. A small part of the Agulhas Stream flows both over and around the Agulhas Bank to the region between Cape Agulhas and the Cape of Good Hope. Some idea of the resulting temperature gradient is given by the following data: Durban has a mean annual surface sea temperature of 21.8° C., a maximum mean monthly temperature (Feb.) of 24.65°, and a minimum mean monthly temperature (Aug.) of 19.25°; for Port St. Johns the corresponding figures are 19.3°, 21° (Jan.), and 16.8° (July); for East London the corresponding figures are 17.6°, 19.15° (Jan.), and 15.7° (Sept.); for Knysna Heads the corresponding figures are 16.8°, 19.85° (Feb.), and 13.5° (Aug.). The Dwessa—Port St. Johns area undoubtedly is merely a stretch of coast where the maximum and minimum temperatures of intertidal and upper sublittoral water exceed the limits of tolerance of several species, in both directions: in this region the eastward limit is reached by *C. stephensiae*, *C. pelliculare*, and *C. tenue*, the westward limit by *C. prostratum*, *C. capitatum*, and *C. pocockiae*. In this instance a relatively straight coast with uniform temperature gradient cumulatively has the same effect as

conspicuous physiographic barrier. The distribution of *Codium* confirms Stephenson's (1944, p. 279) assessment of the biogeographic importance of this area, although he found the effect more apparent among animals than among seaweeds.

On the west coast, under the influence of the prevailing southerly and south-easterly winds, the surface layers of water are carried away from the coast, and upwelling of cold water from moderate depths (Antarctic Intermediate Water) takes place in most seasons. This portion of the anticyclonic circulation of the South Atlantic Ocean, called the Benguela Current, establishes a temperature gradient of such a nature that the region of coldest inshore water lies between Hondeklip Bay and Lüderitz Bay, moving north and south over a distance of 280 miles during the year. At Cape Town* the mean annual surface sea temperature is 12.8°, the maximum mean monthly temperature is 13.6° (Dec., Jan., Apr.), and the minimum mean monthly temperature 12.4° (Sept.); the corresponding figures for Walvis Bay, just within the tropics, are 16.1°, 18.4° (Jan.), and 13.4° (July). Approximate mean annual temperatures of some intermediate localities are Hondeklip Bay, 12.04°; Port Nolloth, 12.3°; and Lüderitz Bay, 13.1°. The outstanding local deviation from this gradient is Saldanha Bay (mean annual temperature, 14.8°), a large, nearly land-locked lagoon which is subject to a high degree of insolation (Isaac 1956). Correlating the distribution of *Codium* with this temperature pattern, we should note that *C. fragile* occurs at least as far north as Swakopmund, just north of Walvis Bay, the only known record for this species within the tropics. Although temperature data for the eastern limit (Robberg) of this species are not available, comparison with data for nearby Knysna Heads (cf. above) would suggest that Swakopmund is approximately its northern limit. *C. isaacii*, judging from temperature data for its southern limit (Cape Town), probably does not extend much (if any) beyond Lüderitz, its presently known northern limit. The relatively warm water of Saldanha Bay accounts for more northerly stands of *C. duthieae* and *C. stephensiae* than might otherwise be expected.

At one time the Cape Peninsula was considered a physiographic barrier of major phytogeographic importance due to its separation of the cold west coast and warm east coast currents. From the work of Isaac and of the Ecological Survey, particularly, it is now known that the phytogeographic importance of the Cape, although not greatly exaggerated previously, does not have such a simple hydrographic explanation nor is it manifested in such a simple floristic manner. The marked differences between sea surface temperatures of the two sides of the Cape Peninsula

*Temperature data for Cape Town were taken at Cape Town Pier, which no longer exists because of shore reclamation.

(for Muizenberg the figures corresponding to those given above for Cape Town Pier are 16.6°, 19.6° [Dec.], and 13.1° [June]), especially in summer, must be accounted for by considering False Bay a pocket of warm water resulting from insolation and wind drift which interrupts the decreasing temperature gradient which otherwise would continue from Knysna Heads to Cape Point. The west side of the Cape Peninsula thus has essentially a cold-water flora with an increasing admixture of south coast species toward Cape Point, while the east side has an essentially south coast flora with an admixture of west coast species decreasing away from Cape Point. In this region of rapid transition *C. isaacii* reaches its southern limit while *C. papenfussii* and *C. platylobium* reach their western limit.

The hydrography of the south coast is complex. The region from Knysna Heads west to Cape Point is not directly under the influence of the main portion of either the Benguela Current or the Agulhas Stream, although a small part of the former enters False Bay, especially in winter, and small branches of the latter enter the region from the east. Wind, acting in conjunction with the configuration of the coast, has a marked influence on the temperature of these coastal waters. The prevailing south-east winds of summer pile up warmer surface waters against those shores whose configuration is such that these waters are entrapped, as at Cape Agulhas and Struis Bay. The same winds, however, blow the warmer surface waters away from those shores which trend in a direction more or less parallel to that of the wind, causing upwelling of cold water. This accounts for the marked difference in the maximum mean monthly temperature (summertime) between the two sides of Cape Agulhas (as well as between the two sides of the Cape Peninsula), and thus explains why such capes are effective barriers to the eastward spread of cold-water forms and to the westward spread of warm-water forms. The maximum mean monthly temperature of Cape Agulhas is 20.9° (Jan.), the same as at adjacent Struis Bay and higher than that of any locality east to Port St. Johns. The mean annual temperature of 17.7° for Cape Agulhas thus is higher than would be expected were the east coast gradient to continue uniformly from Knysna Heads. By contrast, the maximum mean monthly temperature of Danger Point, just west of Cape Agulhas, is only 17.1° (Jan.), indicating summertime upwelling. The lower temperatures west of Cape Agulhas apparently are critical to three species of *Codium*, which reach their westward limit in this region: *C. extricatum*, *C. lucasii*, and *C. pelliculare*.

In summary, on the basis of centre of distribution together with range limits, the South African species of *Codium* fall into the following geographic groups:

I. Species with centre of distribution in cold water [mean annual surface temperature approximately 12°—12.5°].

   A. West coast cold-water species: *C. isaacii.*

   B. West and south coast cold-water to cool-temperate species: *C. fragile.*

II. Species with centre of distribution in temperate water [mean annual surface temperature approximately 17°—19°].

   A. South coast cool-temperate to warm-temperate species: *C. stephensiae, C. incognitum, C. papenfussii, C. platylobium, C. pelliculare, C. tenue, C. megalophysum.*

   B. South and east coast cool-temperate to warm-temperate and subtropical species: *C. duthieae, C. extricatum, C. lucasii.*

III. Species with centre of distribution in warm water [mean annual surface temperature greater than 20°]:

   A. East coast subtropical species: *C. prostratum, C. capitatum, C. pocockiae, C. spongiosum.*

   [B. Subtropical to tropical species, ranging from Mozambique northward an unknown distance: *C. acuminatum, C. cicatrix, C. mozambiquense.*]

Finally, it may be noted that Cape Padrone, postulated by Stephenson as the dividing point between the east and south coasts, apparently has no effect on the *Codium* flora.

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FRANCIS MASSON, A GARDENER-BOTANIST WHO COLLECTED AT THE CAPE.

By Mia C. Karsten

(With Plate XVII)

II. MASSON'S JOURNEYS AT THE CAPE

As we have seen, Masson was sent to the Cape twice. His first voyage to that part of the world was in Captain Cook's vessel the *Resolution* which sailed from Deptford, England, on April 9, 1772. But the ship got no farther than Woolwich where she was detained by easterly winds till the 22nd. Via Long Reach and Sheerness, where she had to undergo some alterations in her superstructure, the *Resolution* reached Plymouth Sound, whence she ultimately sailed for the Cape, with the *Adventure* in company, on July 13. The ships dropped anchor in Table Bay on Friday, October 30[36].

Only of Masson's first visit to the Cape, during which he undertook three journeys into the interior, we have an account, viz. the paper already referred to, published in the Philosophical Transactions of the Royal Society, 1776, pp. 268–317. His report appeared under the title: *An Account of Three Journeys from the Cape Town into the Southern Parts of Africa; undertaken for the Discovery of New Plants, towards the*

[36] Cook, *A Voyage towards the South Pole and round the World*, Vol. I of 2nd ed. (1777), pp. 1–5, 15.

Improvement of the Royal Botanical Gardens at Kew. By Mr. Francis Masson, *one of his Majesty's Gardeners. Addressed to Sir* John Pringle, *Bart.* P.R.S.[37].

After his return to Kew, MASSON prepared the narratives of these three journeys, each of which he appears to have sent to Sir JOHN as soon as it was ready. On February 1, 1776, he wrote to him: "Sir, In compliance with your request, I now send you the account of my first journey from the Cape, which I have transcribed from my journal; and if you shall find it to contain any thing worthy the notice of the Royal Society, I beg you would do me the honour to present it to that illustrious Body; and believe, that with the greatest pleasure I shall communicate to you and to them the remaining part of my observations. I am, &c." This little note certainly bears testimony to MASSON's modesty.

MASSON's account is rather short as compared with the travel books by THUNBERG and SPARRMAN, but it is written with obvious enthusiasm and a genuine interest in the country and its wild life, animals as well as plants. In addition to this we may quote what THUNBERG writes about MASSON in the Preface to Vol. II of his *Travels*[38]: "Mr. MASON, a skilful English gardener, who accompanied me in both my journies into the interior part of the almost unknown continent of Africa, has, it is true, on his arrival in England, given a short account of both these voyages, in a letter to Sir JOHN PRINGLE, then President of the Royal Society at London, which is inserted in the Philosophical Transactions . . ., together with the relation of his first journey in company with M. OLDENBURG. But as that narrative is very short, and the transactions of the society could not admit a more full and ample detail, it is hoped that this part of my narrative will not be considered as superfluous."

We will give a summary of the route covered on each of these three journeys, followed by fragments of his account, which are of special interest to the naturalist or remarkable for some other reason.

Most of the geographical names as recorded by MASSON are misspelled or in the high Dutch of those days. We shall give the modern names with the MASSON names following in brackets, unless the difference is negligible.

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[37] Sir JOHN PRINGLE (1707–82) was a physician who, while practising with great success in London, attained a position of great influence, especially in scientific circles. On November 30, 1772, he was elected President of the Royal Society, after having been a fellow for several years. PRINGLE's scientific merits were recognized by his being chosen, in 1778, in succession to LINNAEUS, one of the eight foreign members of the Academy of Sciences at Paris. His great work in life was the reform of military medicine and sanitation.

[38] THUNBERG, *Travels*, etc., Vol. II of 2nd ed., Preface, pp. vi–vii (1795).

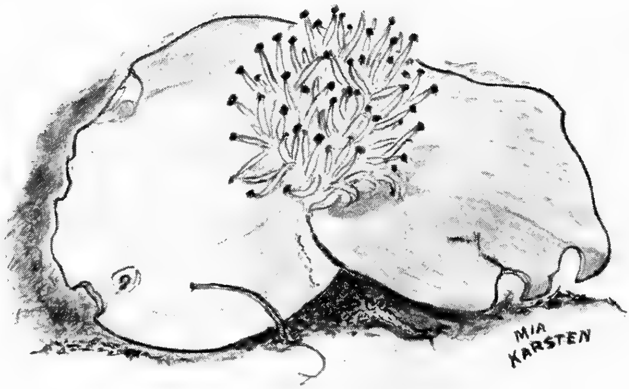

PLATE XVII. *Massonia huttoni*, Baker.

Pale mauve inflorescence; very fragrant! The stamens, interspersed with styles, in a crowded mass, form the most conspicuous part of it. Slightly above natural size.

Out Cradock Road, Grahamstown.

First Journey into the Interior (Dec. 1772—Jan. 1773)

Masson's companions on this journey were "a Dutchman"—as he calls him—and a Hottentot who drove his waggon which was drawn by eight oxen. As mentioned before, his European fellow-traveller in reality was a Swede of the name of Franz Pehr Oldenburg. As the man was a private soldier, formerly in the service of the Dutch East India Company, this may have induced Masson to refer to him as a Dutchman. Both in Thunberg's *Travels* and *Flora Capensis* Oldenburg is recorded as Masson's companion on this journey. In the latter work, speaking of Masson, Thunberg says: "Anno 1772 brevius cum D. Oldenburg iter instituit"[39].

They set out from Cape Town in N.E. direction on December 10, 1772, towards the evening. They passed the Tygerberg, leaving it at their left. Then they proceeded to the Paardeberg which they passed, and, turning to the east, they crossed the Great Berg River and entered the Drakenstein (Draakensteen) valley. They pursued their journey to Paarl (Perel) and from there to the Fransch Hoek valley. On January 4 they reached Stellenbosch, and the next day they travelled along the foot of the Stellenbosch mountains to Hottentots Holland. After crossing the Palmiet and Bot Rivers (Boter (!) R.), they arrived at a hot bath, situated on the S.E. side of the Zwartberg: the later Caledon baths. Thence they proceeded to the Zonder End River (River zonder Eynde), and after crossing it, they arrived at Zoetemelksvlei (Sweet Milk Valley), a post of the Dutch East India Company, where they stayed for five days. After having forded the Breede River at the place where the Zonder End River joins it, they arrived at Swellendam (Schwellendam), where they remained for two days. Thence they returned to the Cape by much the same route, as is learnt from Masson's last entry in his journal, dated January 18.

The following may be quoted here from his narrative of this journey in the summer of 1772–73, which hardly covers eight pages of the Phil. Trans. (pp. 269–276).

After crossing the Salt River they reached a large sandy plain, now known as the Cape Flats, about which Masson writes (p. 269): "The soil of this plain is unfit for cultivation; being a pure white sand, blown by the S.E. wind from the shore of Falso Bay, and often forming large hillocks; it is, nevertheless, overgrown with an infinite variety of plants peculiar to this country."

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[39] Transl.: "In the year 1772 he undertook a shorter journey together with Mr. Oldenburg", Thunberg, *Flora Capensis*, ed. Schultes (1832), p. 6. In addition to this Thunberg gives a few notes on Oldenburg's life and work (pp. 6–7); see this Journal, Vol. V, Oct., 1939, p. 136, footnote 146, and also Vol. XXIII, April, 1957, p. 53, footnote 3.

He was rather impressed by the vegetation of the Hottentots Holland Mountains, as we learn from the following quotation (p. 273): "These mountains abound with a great number of curious plants, and are, I believe, the richest mountains in Africa for a botanist." Immediately after this he proceeds to the Palmiet River, and gives a rough sketch of the plant from which it derives its name, viz. " . . . the Palmet River, so called by the peasants from a plant which almost covers the water; the leaves of which greatly resemble that of the ananas or pine-apple, but their flowers are like those of a reed." In a footnote the scientific name of the "Palmiet", a plant belonging to the Juncaceae, common in watercourses and marshy ground, and extending from the Clanwilliam district through the coastal regions of the Cape to Natal, is mistakingly given as Schoenus serratus. The gen. *Schoenus*, L. is a member of a different family, viz. the Cyperaceae. The proper name of the "Palmiet" is *Prionium palmita*, E. Mey. (syn. P. serratum, Drège; Juncus serratus, L. f.).

On the fourth day of their stay at Zoetemelksvlei they went into the woods which, as MASSON tells us, are about half-way up a high chain of mountains extending along the N. and N.E. side of the valley. Although no name is given, MASSON obviously refers here to the Zonder End Range. After having related an encounter with "wolves" (jackals?), MASSON writes (pp. 274–5): "We afterwards climbed over many dreadful precipices till we arrived at the woods; which are dark and gloomy, interspersed with climbing shrubs of various kinds. The trees are very high; some from eighty to a hundred feet; often growing out of perpendicular rocks where no earth is to be seen. Among these the water sometimes falls in cascades over rocks two hundred feet perpendicular, with awful noise. I endured this day much fatigue in these sequestered and unfrequented woods, with a mixture of horror and admiration. The greatest part of the trees that compose them are unknown to botanists. Some I found in flower; others, which were not so, I am obliged to leave for the researches of those who may come after me in a more fortunate season."

MASSON ends his narrative of his first journey inland with the following words (pp. 275–6): "It was on this journey that I collected the seed of the many beautiful species of *ericae* which, I find, have succeeded so well in the Royal Garden at Kew."

SECOND JOURNEY INTO THE INTERIOR (SEPT. 1773–JAN. 1774)[40].

It was THUNBERG who planned and arranged this journey and asked MASSON to accompany him. We may quote here what THUNBERG writes

[40] A summary of the route covered by THUNBERG and MASSON on the second and third journey into the interior, is given in this Journal, Vol. V, Oct., 1939, pp. 137–9

about his companion on this expedition, the other members of their party and their equipment, in his *Travels* (Vol. I, pp. 316–17): "For my fellow-traveller I had an English gardener, of the name of MASON, who had been sent hither by the King of England to collect all sorts of African plants for the gardens at Kew. Mr. MASON arrived the year before, in the same ship in which Captain COOK, with the professors FORSTER and SPARRMAN[41], were to make their celebrated voyage round the world, and towards the southern pole. He had arrived at the Cape after I was set out on my journey to Caffraria; and shortly after this he made an excussion into the country, accompanied by Mr. OLDENBURG, who went with him, partly as his companion and partly as his interpreter. Mr. MASON was well equipped with a large and strong waggon tilted with sail-cloth, which was driven by an European servant, upon whom he could depend. We had each of us a saddle-horse, and for our waggon we had several pair of oxen. Thus we formed a society, consisting of three Europeans and four Hottentots, who for the space of several months were to penetrate into the country together, put up with whatever we should find, whether good or bad, and frequently seclude ourselves from almost all the rest of the world, and of the human race." It should be added that for this journey THUNBERG had obtained a brand new cart, tilted with sail-cloth, of which he was the sole possessor, instead of the old broken one used in the previous year (*loc. cit.*, p. 315).

The party left Cape Town on September 11, 1773, and, directing their course along the N.W. coast, they passed the Blaauwberg mountains, proceeded to Groene Kloof, passed the Conter Berg, whence they entered a large barren country, named "Zwart Land" by MASSON, which is the Malmesbury–Darling area. Travelling in the same direction, they arrived at Saldanha Bay on September 22. Thence they journeyed to Witte Klip, later they arrived at St. Helena Bay. After crossing the Great Berg River, they entered the 24 Rivers district. Through the Kardouw Pass they crossed a branch of a chain of mountains, not named by MASSON, but undoubtedly the Olifants River Mts. After crossing the Olifants River, they entered the Olifants River Valley, bounded on each

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and 146–9. The accompanying map shows the routes, also of THUNBERG's first journey into Caffraria. This part of our paper on THUNBERG was written in Holland shortly before the war. It was rather a tricky job, and we lacked the expert help experienced in this country. In particular the route covered on the journey into Roggeveld was difficult to trace, resulting into various inaccuracies on the map, *inter alia*: THUNBERG and MASSON travelled to the *west* of the Piquetberg, instead of to the east; they passed *west* of the Matsikamma Mts.; it was *not* by crossing the Roggeveld Mts. that they reached the Lower and Middle Roggeveld.

[41] This is incorrect as far as SPARRMAN is concerned. He did not come out to the Cape together with the FORSTERS and MASSON, but arrived in a vessel of the Swedish E. I. Company, the *Castle of Stockholm* (Stockholms Slott), over seven months before he sailed in the *Resolution* for the Antarctic, etc.

side by high mountains (the Olifants and Cold Bokkeveld Mts.). The hot bath in this valley mentioned by MASSON is now known as The Baths in the present Clanwilliam district. They travelled along the banks of the Olifants River as far as Citrusdal, and after an attempt to cross a high ridge of mountains (the Cold Bokkeveld Mts.) on the east side, which was found impracticable, they sent the waggons over Greys Pass to a place called by MASSON "Rood Land" (=Roodezand, the present Tulbagh valley), while THUNBERG and MASSON, journeying on horseback, directed their course to the south-east. They went through Elands Kloof (a passage through the Cold Bokkeveld Mountains), after which they entered the Cold Bokkeveld. By a very steep path they descended into another small country, the Warm Bokkeveld. They went through the mountains at the position of the present Michells Pass, and crossing the Breede River, they arrived at Roodezand where they found their servants and vehicles. They ascended the Great Winterhoek Mountain on the north of Roodezand. They continued their journey downstream along the banks of the Breede River. After crossing the Goree River (Ko Aree R.), which is seven miles west of where Robertson is now situated, and the Kogmans Kloof River at Ashton (MASSON's "Koekman's Rivier"!), they reached Swellendam. Pursuing their journey, they came to the Duivenhoks River, which they forded. After crossing the Kaffirkuils and Gouritz (Goud's) Rivers, they arrived at Mossel Bay, whence they travelled in northern direction towards the mountains (Attaquas and Outeniqua Mts.), which they crossed by way of the Attaquas Pass (Hartequas Kloof), which is about seven miles west of the present Robinson Pass. They entered a valley, called "Canaan's Land" according to MASSON[42], which is now known as the Little Karroo. Thence they went to the Great Doorn River and entered the Lange Kloof, bounded on the south by the Outeniqua Mountains. After crossing the Kromme River, they arrived at Essenbosch. Continuing their journey, they came to Seekoe River near the present Humansdorp, and, crossing the Gamtoos and Van Staadens Rivers, they reached the Zwartkops River and Saltpans near Algoa Bay. Thence, directing their course inland, they travelled beyond the Bay as far as the Sundays River. This was their farthest afield: they returned to the Cape by the direct route. Having come to Lange Kloof again, MASSON and THUNBERG made a journey on horse-

[42] MASSON must have misunderstood the name given to this area by the colonists. There is little doubt that the proper name was not "Canaan's Land", but "Canna Land", owing to the Canna-bushes, *Salsola aphylla*, L. f. (Chenopodiaceae), which are frequent in the Little Karroo (cf. THUNBERG in his narrative of the same journey, *Travels*, Vol. II, p. 104; see also this Journal, Vol. V, Oct., 1939, p. 139).—*Salsola aphylla*, known as Brakganna, Soutganna, Kanna or Ganna, has been used to supply the alkali for soap-making (THUNBERG), moreover it is of great value as a fodder plant.

back to a hot bath beyond the Kamanassie Mountains on the north side of the Kloof. This hot bath has been identified as Hot Springs near Toverwater Poort. They arrived back at Cape Town on January 29, 1774.

We will now quote some of MASSON's observations in the spring and summer of 1773–74.

Near Saldanha Bay—at the end of September—they found a great variety of curious plants, but only one plant is specially mentioned (pp. 277–8): " . . . a large bulbous root, growing on dry precipices, which the Dutch call *vergift-boll,* poison bulb; the juice of which, they say, the Hottentots use as an ingredient to poison their arrows. We found it to be a species of *amaryllis,* and, by the leaves growing in a fan shape, we called it *amaryllis disticha*[43].

About Witte Klip, on their way from Saldanha to St. Helena Bay, MASSON writes (p. 278): " . . . being a white granite stone of an enormous size; from the top of which we had a charming view of the sea coast from St. Helena Bay to the Cape of Good Hope. The whole country affords a fine field for botany, being enamelled with the greatest number of flowers I ever saw, of exquisite beauty and fragrance . . . "

Near St. Helena Bay they found the Great Berg River on both sides bordered with marshes which are overgrown with a reed vegetation (pp. 278–9): "Those reeds are plentifully stocked with birds of various sorts, which build their nests upon such of them as hang over the water. There is one bird, in particular, which has a wonderful effect among the green reeds; its body being a bright crimson, with black and grey wings; and by the brightness of their colours, when sitting among the reeds, they look like so many scarlet lillies; this is the *loxia orix* of LINNAEUS[44]. There are still some of the sea horse, or *hippopotamus amphibius,* in this river; but it is now prohibited to shoot any of them, as they are nearly destroyed for 800 miles from the Cape. . . . We came to the pont or

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[43] Now called *Boöphone disticha,* (L. f.) Herb. (syn. Amaryllis disticha, L. f. (non Thunb.!); Haemanthus toxicarius, Ait.; Buphane disticha, (L. f.) Herb.). This is The Cape Poison Bulb or Sore Eye Flower (Gifblom and Seeroogblom in Afrikaans). The Bushmen have also used preparations of this bulb as one of the ingredients for poisoning arrows intended for shooting small game (cf. THUNBERG in his narrative of the journey to the Roggeveld, *Travels,* Vol. II, p. 163, quoted in this Journal, Vol. V, Oct., 1939, p. 150). The old colonists used it as an antiseptic for wounds, the scales of the bulb being dipped in oil or water and placed on the wound. Its inflorescence—numerous sweet-scented flowers of a light red colour, arranged in a dense umbel—is very showy.

[44] This picturesque bird is the Red Bishop Bird, Quelea, or Rooivink, now known under the name of *Pyromelana orix orix* (syn. Euplectes orix). The description we found of the male bird greatly matches the short picture MASSON gives of it. The top of the head, back, lower throat, and tail coverts above and below are orange scarlet, the rest of the plumage is velvety black, while the wing quills are brown with blackish centres. The red bishop birds come in countless thousands like locust-swarms, and are common in marshes.

ferry, where we collected a great number of beautiful plants, particularly *ixiae*, *irides*[45], and *gladioli*."

Referring to the hot bath in the Olifants River valley, MASSON writes (pp. 280–1): "There is a hot bath here, which we visited, issuing from the side of a mountain. The water was nearly boiling hot at the place it issued out of the rock; and the people who used it affirmed, that it was hot enough to boil a piece of meat. I observed an orangetree, which had been either raised from a single seed, or planted when very young, in a seam of the rock where the water boiled out, which, to my surprize flourished amazingly, and all the sides of the bason where the people bathed were matted round with the fibres."

Travelling along the banks of the Olifants River, they found the country rather luxuriant (p. 281): "The meadows yielded excellent pasture for our cattle[46], the grass reaching up to their bellies, but of a coarse texture, being chiefly *Juncus*, *scirpus*, and *cyperus*."

About the vegetation in the Elands Kloof MASSON writes (p. 282): " . . . we saw few plants here, only some trees of the *protea grandiflora*[47] thinly dispersed along the skirts of these mountains [Cold Bokkeveld Mts.]."

When they arrived in the Warm Bokkeveld towards the end of October, they traversed through fertile grassland, the grass reaching to their horses' bellies, and "enriched with great variety of *ixiae*, *gladioli* and *irides*, most of which were in flower at the Cape in the month of August" (p. 283).

MASSON and THUNBERG experienced great difficulty in fording the upper course of the Breede River, its bed being filled with huge stones, which tumble down from the sides of the mountain. They had to cross the river no less than four times! But their labour was largely repaid as they stumbled upon a great number of rare plants on the opposite side. MASSON writes about this (p. 284): "The bank of the river is covered with great variety of evergreen trees; viz. *brabejum stellatifolium*, *kiggelaria Africana*, *myrtus angustifolia*[48], and the precipices are ornamented with *ericae* and many other mountain plants never described before."

We may now quote what is recorded on pp. 284–5 about the vegetation of the Great Winterhoek Mountain (one of the highest mountains in the Cape Province and often snow-capped in winter), which they

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[45] The plants referred to by MASSON in his account as "irides" are various species of *Morea*.

[46] The oxen which draw their waggons, and probably also their riding-horses are meant here.

[47] *Protea grandiflora*, Thunb., the Wagenboom or Waaboom.

[48] *Brabeium stellatifolium*, L., Wild Almond or Wilde Amandel (Proteaceae); *Kiggelaria africana*, L., Wild Peach, Wilde Perske or Spekhout (Bixaceae); Myrtus angustifolia, L.=*Metrosidoros angustifolia*, Sm. (Myrtaceae).

ascended soon after their arrival at Roodezand. "Here we expected to find plants that ought endure the severity of our climate [in England and Sweden]; but when we arrived at its top, we found nothing but a few grasses, *restiones*, and *elegiae*[49]; the whole mountain consisting of rock, lying in horizontal *strata*, without any sort of earth, except a little decayed rock in which the grasses grew."

They continued their journey along the banks of the Breede River, where they collected "many remarkably fine flowers." The plant which struck them in particular, was, quoting MASSON (p. 285), " . . . one of the liliaceous kind, with a long spike of pendulous flowers, of a greenish azure colour, which among the long grass had an admirable effect (this is *ixia viridis*[50])."

Near the Goree River, which they reached on October 31, they found many new plants, particularly "*gerania* and *stapeliae*" (p. 286).

Then they passed on to the Kogmans Kloof River, "the banks of which", as MASSON tells us (p. 286), "are covered with thick woods, and furnished with a variety of birds, which afforded us great sport. The trees were mostly of *mimosa nilotica* of LINNAEUS[51]; the species of the birds I have not yet determined, not being provided with books upon Ornithology to settle one half of those which I collected on this journey."

It was on November 5 that they arrived at Swellendam, and on the very same day they dined with the "Land Drost". As Masson does not give the name of their host, we may add that the then landdrost of Swellendam was Mr. J. F. MENTZ[52].

Fording the Duivenhoks River on November 11, THUNBERG had a narrow escape. We find the incident described by MASSON as follows (pp. 286–7): "The Doctor imprudently took the ford without the least inquiry; when on a sudden, he and his horse plunged over head and ears into a pit, that had been made by the *hippopotamus amphibius*, which formerly inhabited those rivers. The pit was very deep, and steep on all sides, which made my companion's fate uncertain for a few minutes; but, after several strong exertions, the horse gained the opposite side with his rider." THUNBERG's own version of the mishap, as given in *Travels*, Vol. II, pp. 46–7, is somewhat different. . . . The night previous to the crossing they spent on a farm nearby, and, continuing in THUNBERG's own words, "having taken an early leave of our worthy

[49] *Restio* and *Elegia* spp. (Restionaceae).

[50] Ixia viridis, Thunb. = *Ixia viridiflora*, Lam., the Green Ixia or Groen Kalossie. MASSON has classified this iridaceous plant erroneously with the Liliaceae.

[51] Mimosa nilotica, Thunb. (non Linn.!) = *Acacia karroo*, Hayne (syn. A. horrida, Willd.), Thorntree, Karroo Thorn, Doringboom or Karroodoring.

[52] JOACHIM FREDERIK MENTZ was a Hollander who came out to the Cape in 1749. After having held the office of secretary of the Swellendam district for a number of years, he was appointed landdrost in 1766. About the landdrost's duties MASSON says that he is a justice of peace and collects different taxes for the peasants (p. 286).

hostess, we went down to Duyvenhoek's river, which was at a short distance from the farm. The late rains had filled this rivulet, so as to make it dangerous to cross. The rivulets of this country, however, have usually some shallow places, where, even in the greatest flood, one may cross them with waggon and oxen. To shew us one of these drifts (as they are called) our hostess has been so kind as to send a slave with us; but, as he neither understood nor spoke Dutch, he was obliged to communicate his instructions to us by signs, which, either from ignorance or malice, he entirely perverted, as he pointed out to us a circular track over the river to the right, which we ought to have taken to the left. I, who was the most courageous of any of the company, and, in the whole course of the journey, was constantly obliged to go on before and head them, now also, without a moment's consideration, rode plump into the river, till, in a moment, I sank with my horse into a large and deep sea-cow hole, up to my ears. This would undoubtedly have proved my grave, if my horse had not by good luck been able to swim; and I, who have always had the good fortune to possess myself in the greatest dangers, had not, with the greatest calmness and composure, guided the animal (which floundered about violently in the water) and kept myself fast in the saddle, though continually lifted up by the stream. After having passed over this hole, I was likewise successful in my attempts to get safe out of it, though the edges of these holes are in general very steep, in so much that they seldom afford one a sure footing. Holes of this kind which the Hippopotamus treads out for its resting place, occur in a great many rivers, though the animal itself perhaps is no longer to be found there, but has either been shot, or made to fly to some other more secure retreat. All this time my fellow travellers stood frightened on the opposite bank and astonished, without daring to trust themselves to an element that appeared to them so full of danger. However, as soon as I had got off my horse and let the water drain off from me a little, I ordered my Hottentots to drive across the river, according to a better direction that I gave them, after which the others followed.

I had the greatest reason to be thankful to the divine Goodness, which had preserved me in this imminent danger, and the more so, as it happened on the anniversary of the day on which I came into the world thirty years before."

Having crossed the Kaffirkuils River, they found a country consisting of valleys and low hills which were easy to climb, lying between a range of mountains, the Langebergen, and the sea. "On the declivities of these low hills", quoting MASSON (p. 287), "grows the *aloe Socotorina*[53] in large

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[53] This is *Aloe succotrina*, Lam. (syn. A. soccotrina, Garsault; A. soccotorian (J. A. et J. H. Schultes).

clumps, which when old have stems about five or six feet high, with only a few thick leaves on their tops, that at a distance appear like bands of Hottentots. The peasants make great quantities of the gum aloes from the sap of the leaves, which they sell at the Cape from two to six pence per pound. . . . "

On November 15 they reached the Gouritz River, which they found in flood. The river was about 100 yards broad and the water so high that it came up to the seat of their saddles, as recorded on p. 287. This part of the country proved to be a rich hunting ground for the plant collector, according to MASSON's description (pp. 287–8): "On each side of this river lies an extraordinary track of land, which in the Hottentot language is called Carro. It is a dry, burning soil, of a reddish colour, intermixed with rotten rock, and intirely divested of grass; but enriched with an infinite number of evergreen shrubs, both frutescent and succulent: among the latter we found many new species of *crassula, cotyledon, euphorbia, portulaca, mesembryanthemum.*" The "Carro" land referred to must be part of the Little Karroo.

Half a month later, on December 1, they came to the Seekoe River. They took their lodging at the house of a farmer, "*Jacob Kock*, an old German . . . " (p. 291)[54]. They rested here for eight days, and did a lot of collecting in the adjacent woods and fields. About plants which drew their special attention, we read (p. 292): "We found here a new palm, of the pith of which the Dutchman told us the Hottentots make bread; but we could get no satisfactory account of their method of making it. We observed two species; one about a foot and a half diameter in the stem, and about twelve feet high, with entire leaves; they appeared to be very old, and seldom bore fruit. The other sort had no stem, with the leaves a little serrated, and lying flat on the ground, which produced a large conical fructification about eighteen inches long, and a foot or more in circumference; squamose, and under each of the *squamae*, is an oval nut, about the size of a chesnut, of a beautiful red colour, but insipid taste. The male plant is similar to the female, only not producing fruit, but bearing a *strobulus*, and containing the *pollen*, or male-dust, in small cells underneath its *squamae*[55]. In the woods here we found the

[54] This was JOHANNES JACOBUS KOK (sometimes spelt KOCK), a hospitable and industrious Hessian, who had built a handsome house on the north bank of the Seekoe River, St. Francis Bay, and surrounded it with gardens and vineyards. SPARRMAN and PATERSON were to stay with him too on their journeys. KOK died just before or in 1786. The above information we owe to FORBES (his thesis *The Expanding Horizon*, 1957).

[55] The new "palm" of THUNBERG and MASSON, the Kaffir Bread-tree, is not a member of the palm family, but was later found to belong to a separate family, the Cycadaceae. Moreover, the S. African Cycas or Zamia species were included in a new genus, *Encephalartos*, Lehm. As to the identity of the two species described by MASSON, it is beyond doubt that the 12 feet high species is *E. longifolius*, Lehm.

euphorbia antiquorum[56] forty feet high. The inhabitants observe, that the honey found near these trees is unwholesome."

After crossing the Gamtoos River, they came to the Loeries River (Lory's R.), "so called from a species of parrot[57], which is found here" (p. 294).

Before fording the Van Staadens River, they traversed "a pleasant country, diversified with smooth green hills, interspersed with evergreens, and stocked with numerous flocks of the *capra dorcas* of LINNAEUS, *equus zebra*, and *camelus struthio*; which, together with the fine disposition of the woods and groves, could not but charm us . . . " (p. 294)[58].

On the other side of the Van Staadens River they found "the true Cape jassemine, or *gardenia stellata*[59], and the coral tree, *erethrina corallodendron*"[60] (p. 296). The date was December 12, and the next two days they were journeying in very short stages, employing their time in collecting plants, all of which were new. MASSON continues with the following zoological observation (p. 296): "The buffalo[61] is numerous in this country: it is a fierce animal, and larger than the biggest of our

(syn. Cycas caffra, Thunb., Nova Acta Regiae Societatis Scientiarum Upsaliensis, Vol. II (1775), part of the description, *not* the figure !), which grows in the coastal region where MASSON saw it. The apparently stemless species (it has an under, ground stem) is *E. caffer*, Lehm. (syn. Cycas caffra, Thunb., *loc. cit.*, tab. V and part of the description; Zamia caffra, Thunb., Prodr. Pl. Cap., Vol. II, p. 92 (1800), and Fl. Cap. ed. Schultes, p. 429, partly (1832)], which is also found near Seekoe River. In his original description, in which he confused the two species, THUNBERG introduced the dwarf stemless one as the true *E. caffer* ("Cycas caffra"). See HUTCHINSON and RATTRAY, Cycadaceae, in *Flora Capensis*, Vol. V, Sect. 2 (Suppl.), 1933. The notes on the Bread-tree in THUNBERG's *Travels*, Vol. I, p. 201, and Vol. II, pp. 66–67 (quoted in this Journal, Vol. V, Oct., 1939, pp. 126 and 141) definitely refer to these two species.—By *strobulus* and *squamae* the more or less cone-shaped inflorescence and the scales forming part of it, are meant.

[56] What is called "Euphorbia antiquorum", by MASSON is most likely *E. triangularis*, Desf., a treelike species with stems of 30–40 feet high, and common in these parts.

[57] This is the Knysna Loerie, *Turacus corythaix*, common in the coastal districts of the eastern Cape. It is a green bird with a white-topped crest, and with red wings (very showy when flying). MASSON was not far wrong, calling the loerie a kind of parrot, as the family it belongs to, the Musophagidae (peculiar to Africa), is placed between the parrots and the cuckoos by most authorities.

[58] Capra dorcas=*Alcelaphus caama caama* (SPARRMAN's Antilope dorcas !), Cape or Red Hartebeest, Rooihartbeest; *Equus zebra zebra*, Cape Mountain Zebra, Bergkwagga; *Struthio australis* (syn. S. camelus), Ostrich, Volstruis.

[59] Gardenia stellata (?). We failed to trace this name. What we know as True Cape Jasmine is not a *Gardenia* at all, but a plant named *Jasminum tortuosum*, Willd. (Oleaceae), with sweetly scented white or yellow flowers. But its distribution in the coast region of the Cape—Humansdorp Division and Kabeljouws River—practically rules out that this was the plant mentioned by MASSON. There is another species, *J. angulare*, Vahl (syn. J. capense, Thunb. !), scarcely different from the former, which is found *inter alia* in the Uitenhage Division, on the banks of the Zwartkops River, near Algoa Bay, and this might well have been the jasmine referred to.

[60] *Erythrina caffra*, Thunb. (syn. E. corallodendrum, Thunb.), Coral-tree, Kafferboom. (Legum.).

[61] *Syncerus caffer caffer*, Cape Buffalo, Kaapse Buffel.

English oxen. In the day-time they retire to the woods, which renders it very dangerous to botanize there. We here saw two lions for the first time, at about 4 or 500 yards distance; but they took no notice of us, keeping their eyes upon a clump of the *capra dorcas*, which were feeding at some distance from them. . . . "

Soon they set out on their return journey to the Cape. Travelling from Lange Kloof, where they had left their waggons, to the hot springs beyond the Kamanassie Mountains on December 29, MASSON and his Swedish companion, and some Dutch people who had joined them, traversed a level country, extremely dry, of which MASSON writes (p. 298): "The plains were covered with loose stones, and not a blade of grass to be seen; but we found many rare species of *crassula, mesembryanthemum*, and other succulent plants." Late at night next day they arrived at the bath, which is situated at the foot of a ridge of dry mountains, now known as the Great Zwartberg Range. On the following day they climbed these mountains, and from the summit they had an extensive view of the country beyond: very dry and desolate, part of the Great Karroo. MASSON mentions one single species only of the Zwartberg vegetation (p. 299): "We found here a species of heath remarkable for having its branches and leaves all covered with a fine hoary down or nap, which we thought singular in that *genus*: we called it *erica tomentosa*"[62].

When they had passed on to the Great Doorn River on January 3, MASSON and THUNBERG again parted with their waggons, in order to examine the large tract of Karroo, where they would not take their oxen on account of the scarcity of water. Here they lost their way, spent the night in the veld in a thicket of *Acacia karroo*, and in the early morning of the 4th, MASSON climbed up a high precipice, and had a look at the country. His effort was not fruitless, for he writes (p. 300): "Here I collected several curious plants, *geranium spinosum, stapelia euphorbioides*"[63]. So far MASSON'S account of this journey.

THIRD JOURNEY INTO THE INTERIOR (SEPT.–DEC. 1774)

During the months previous to the third journey inland, which had the Roggeveld as its aim, MASSON went on various excursions on the Peninsula together with THUNBERG, and also an English lady of noble

[62] The identity of this *Erica* species of the Great Zwartberg is rather doubtful. The heath known under the name *E. tomentosa*, Salisb., is found in the coastal districts of the Cape, and more inland near Genadendal and in the mountains near Zoetemelksvlei. We did not come across any locality in the central part of the country. There are more *E.* species with pubescent leaves and flowers.

[63] Geranium spinosum, Burm.=*Sarcocaulon burmanni*, Sweet, Candlebush, Kersbos (Geraniaceae).—Stapelia euphorbioides (?): there is no Stapelia of that name, but in view of the specific name, we wonder whether the plant collected by MASSON is not one of the species on which much later the gen. *Caralluma* was founded by ROBERT BROWN.

birth, who stayed at the Cape on her way to India. It is interesting to learn what THUNBERG writes about this in *Travels*, Vol. II, p. 132: "There had arrived from England, in order to proceed to Bengal, Lady Ann MONSON[64], who had undertaken this long and tedious voyage, not only for the purpose of accompanying her husband, who went out as colonel of the regiment in the East Indies [!]; but also with a view to indulge her passion for natural history. This learned lady, during the time she stayed here, made several very fine collections, and particularly in the animal kingdom. And, as I frequently had the pleasure, together with Mr. MASON, of accompanying her to the adjacent farms, and, at the same time, of contributing greatly to the enlargement of her collections, she had the goodness, before her departure, to make me a present of a valuable ring, in remembrance of her, and of the friendship with which she had honoured me. She was a lady about sixty years of age, who amongst other languages, had also some knowledge of Latin, and had, at her own expence, brought with her a draughtsman, in order to assist her in collecting and delineating scarce specimens of natural history."

BRITTEN, in his article on MASSON in Journal of Botany[65], writes that MASSON does not mention in his account that he was accompanied by THUNBERG also on this journey. This is incorrect as will be seen below. But he does refer to MASSON's letter to LINNAEUS of December 26, 1775, from London[66], in which it is said that he made two successful journeys into the interior with Dr. THUNBERG, and in addition to this he quotes the following from THUNBERG's *Flora Capensis*: "Annis 1773 et 1774 mecum interiora Africes versus orientem et septentrionem peragravit"[67]. We may add to this that also in his letter to the younger LINNAEUS (December 12, 1778, from Madeira, see footnote 66) mention is made of the two journeys.

Regarding the preparation of this journey THUNBERG tells us (*Travels*, Vol. II, p. 134): "I fitted myself out as in the preceding year, in the month

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[64] Lady ANN MONSON, originally Lady ANN VANE, was a great-granddaughter of Charles II from her mother's side. In 1757 she married GEORGE MONSON (1730–76), Indian officer, who was her second husband. They went to India, where she must have done a good deal of collecting, for, as early as 1767, her merits in the field of natural history were recognized by LINNAEUS, who named after her the small genus *Monsonia* (Geraniaceae), now comprising about 40 species, natives of Africa (29 in S.A.), western Asia and eastern India. Later they returned to England, but came out again in 1774 as mentioned above. They arrived in Calcutta in October of that year, and very soon after MONSON, then a colonel, took his seat in the Supreme Council of Bengal. Curiously enough, in the *Dictionary of National Biography* (1894), which gives some records of the MONSONS, nothing is said of Lady ANN's interest in plants and animals, and of her sojourn at the Cape. But the biographer does tell us that she was "a very superior whist-player"! She died in February, 1776.

[65] J. BRITTEN, Journal of Botany, Vol. XXII, 1884, p. 115.

[66] This Journal, Vol. XXIV, October, 1958, p. 211; letter to Linnaeus *fil.*, p. 215.

[67] THUNBERG, *Fl. Capensis*, p. 6 (1832), transl.: "In the years 1773 and 1477 he travelled with me to the interior parts of Africa towards the east and the north."

of September, and again had Mr. MASON, the English gardener, for my fellow-traveller, although he was not much inclined to make any long excursion this year." From this it is quite evident that this journey too was planned and arranged by THUNBERG. MASSON might not have been very keen at the time on another extensive trip because of his low stipend. BRITTEN apparently has also not seen the above passage in *Travels.*

MASSON set out from the Cape on September 26, 1774, accompanied by two Hottentot servants only. They travelled through the great sandy plain between Cape Town and the Hottentots Holland Mountains, which is now known as the Cape Flats. Then they crossed the Eerste River and journeyed along the foot of the Stellenbosch mountains. On October 2 MASSON had reached Paarl (Paarle Kerk !), where, quoting him (p. 302), "I was joined by Dr. THUNBERG." Together they proceeded to Paardeberg, and, directing their course northwards, they later arrived at Riebeek Kasteel mountain. After crossing the Great Berg River, they came to the foot of the Piquetberg. Travelling to the east of it, they reached the Verloren Vlei (a river), which they crossed. Directing their course northwards again, towards the mouth of the Olifants River, they had to pass through a rather desolate country, a kind of sandveld, for seven days, before reaching this river. After crossing the Olifants River near Vredendal, they passed west of the Windhoek and Matsikamma Mountains and reached the Troe-Troe River, near where Van Rhynsdorp now stands. Thence they journeyed northwards over the plains west of the Bokkeveld Mountains, now called the Van Rhynsdorp Karroo, heading for the Zwart Doorn River at the northern termination of the mountains. They ascended the mountains, probably at their northern end near "Die Hel", and travelled southwards to a point not far from Nieuwoudtville. Thence, directing their course to the E.N.E., they proceeded on their journey to the Hantamsberg. They passed round this Berg in a clockwise direction. The open cleft or cut through which they journeyed probably being that which lies between the Agter Hantamsberg and the Ramhoeks Berg. They now traversed the Lower and Middle Roggeveld east of the Roggeveld Mountains, and travelling in south-eastern direction, they descended to the Tanqua Karroo, probably 10 miles west of Verlaten Kloof. Journeying across the Karroo, they reached Gousbloem Kloof (in the Koedoes Mts.). Thence they arrived at the Ongeluks River, which they crossed. They passed Paardeberg on their way to Doorn River. After crossing this river and passing through a valley formed by the mountains between Karroo and Cold Bokkeveld (Karroo Poort), they finally arrived at Verkeerde Vlei, at the eastern foot of the Matroosberg. A few days later they passed through a valley in the mountains to DE VOS's estate near Hex River. On December 17 they reached

Roodezand through Hexriver Kloof. Thence they directed their route past Paardekraal through Koopmans River, and after crossing the Great Berg River, they proceeded to Cape Town, where they arrived on December 29.

MASSON's narrative of this journey yields but few observations which are of special interest to the lover of plants and animals.

On October 9 they climbed the Riebeek Kasteel mountain, which is described as very high, four or five miles long, and with a narrow top. They collected here "many remarkable new plants, in particular a hyacinth, with flowers of a pale gold colour" (p. 303)[68].

A few days later they crossed the Great Berg River, and, quoting MASSON (p. 303): "From thence we proceeded through a barren uninhabited country; consequently were obliged to content ourselves with the shelter of a large *leucodendron*[69], that protected us from the S.E. wind. . . ."

As they passed on to the Piquetberg, MASSON writes (p. 303): "All around the mountain the soil is sandy, but furnished with a great variety of beautiful plants, especially *aspalathi*[70]".

Then travelling towards the mouth of the Olifants River, they found the sandy country they traversed, extremely hot at that time of the year, November. And, using his own words (pp. 304–5), "It was also not a little fatiguing to travel here on horse back, the mole-casts being so deep that the horses fell up to their shoulders every six or seven minutes. This animal is by the Dutch called Land-moll, but differs so much from the European mole, that it does not belong to the same class of animals, but is intirely new. It feeds up on the roots of *ixiae, gladioli, antholizae*[71], and *irides*, often grows to the size of a rabbit, and by some is esteemed good eating. There is another species of the animal, called by the Dutch Bles-moll, which inhabits the hard ground; but seldom exceeds the size of the common European mole[72]. This country is furnished with a

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[68] This must be one of the *Lachanalia* spp. (Liliac.), possibly *L. pustulata*, Jacq., characterized by pale yellow flowers, and widely distributed in the western Cape region, *inter alia* in the Malmesbury Division in which Riebeek Kasteel is situated.

[69] *Leucadendron*, Berg. (Proteaceae). It is difficult to say what species MASSON referred to. It might have been *L. plumosum*, R.Br., which grows into an erect bush of 5—7 feet high, and is rather widely distributed in the western Cape: it is found as far north as the Clanwilliam Division, and more to the west in the Piquetberg region.

[70] *Aspalathus* spp. (Leguminosae).

[71] *Antholiza* spp. (Irid.). For "irides" see footnote 45.

[72] Both animals belong to the Mole-rat family, the Bathyergidae. The one which is called "Land-moll" (we wonder whether this name has not actually been Sandmol (=Sand Mole), for Land-moll does not make any sense), is *Bathyergus suillus suillus*, the Cape Dune Mole-rat, Sand Mole, or Kaapse Duinmol, and is found from the Cape as far north as the Olifants River. Sometimes the ground is riddled with their tunnels. The smaller animal is *Georynchus capensis capensis*, the white-faced Blesmol or Mole-rat, which is distributed from the Cape Peninsula eastwards to the

great variety of elegant shrubs; viz. *enistae*, *partia*, and *aspalathi*"[73].

On November 25 they had reached the Olifants River. Here they found a Dutch habitation, where they rested for several days. About the karroid country this side of the river, which abounded with game, we read (pp. 306–7): "The steril appearance of this country exceeds all imagination: wherever one casts its eyes, he sees nothing but naked hills, without a blade of grass, only small succulent plants. The soil is a red binding loam, intermixed with a kind of rotten *schistus* or slate. Next morning we traversed the adjacent hills, and were surprized to find all the plants entirely new to us. They were the greatest part of the succulent kind: viz. *mesembryanthemum*, *euphorbia*, and *stapelia*, of which we found many new species. The peasant told us, that in winter the hills were painted with all kind of colours; and said, it grieved him often, that no person of knowledge in botany had ever had an opportunity of seeing his country in the flowery season. We expressed great surprize at seeing such large flocks of sheep as he was possessed of subsist in such a desart; on which he observed, that their sheep never ate any grass, only succulent plants, and all sorts of shrubs; many of which were aromatic, and gave their flesh an excellent flavour. Next day I passed through a large flock of sheep, where I saw them devouring the juicy leaves of *mesembryanthemum*, *stapelia*, *cotyledon*, and even the green seed vessels of *euphorbia*; by eating such plants they require little water, especially in winter."

After crossing the Olifants River, they proceeded northwards through a desert-like country, the Van Rhynsdorp Karroo, between the Atlantic and the Bokkeveld Mountains (Bockland Mts.), which is described as follows (p. 309): "It is uninhabitable in summer; but in winter, or during the rainy season, the Bockland people come down with their herds, which by feeding upon succulent shrubs, that are very salt, in a short time grow remarkably fat. There still remains a great treasure of new plants in this country, especially of the succulent kind, which cannot be preserved but by having good figures and descriptions of them made on the spot; which might be easily accomplished in the rainy season, when there is plenty of fresh water every where. But at this season of the year, we were obliged to make the greatest expedition to save the lives of our cattle, only collecting what we found growing along the road side, which amounted to above 100 plants never before described".

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mountains about Tulbagh and Worcester. It is known as very destructive to tuberous crops.

[73] Regarding the first two names, we do not know what MASSON means by "enistae" and "partia", both names being in the plural and most likely not correctly spelt. It is only a guess that "enistae" actually should be Genistae, in which case MASSON designates some shrubs of the Leguminosae family as *Genista* spp.

Ascending the Bokkeveld Mountain, they found "a new species of aloe, called by the Dutch Koker Boom, of which the Hottentots make quivers to hold their arrows; it being of a soft fibrous consistence, which they can easily cut out, leaving only the bark, which is hard and durable. These trees were about twelve feet high, with a strait smooth trunk, about ten inches or a foot diameter and five or six feet in length, which divided into two branches; and those were again sub-divided into two more branches, which terminated in a bunch of thick succulent leaves surrounding the stem, spear-shaped, entire, without spines, and hanging down like the leaves of *dracaena draco*. We did not see it in flower, but by the above characters took it for a new species, and called it *aloe dichotoma*"[74] (pp. 309–10).

About the name of this part of the country MASSON writes (p. 310): "It was called Bockland on account of the amazing quantity of spring bucks[75] which were formerly found there". The number of bucks which constantly remain in there, had considerably dwindled since the Europeans came to settle, but " . . . it generally happens once in seven or eight years, that flocks of many hundred thousands come out of the interior parts of Africa, spreading over the whole country, and not leaving a blade of grass or a shrub".

Our last quotation is from his description of the Roggeveld Karroo, where they were in the second half of November. This is another observation of the use the Hottentots make of certain indigenous plants and animals. On p. 314 it is related: "They . . . poison the arrows with the venom of serpents mixed with the juice of a species of *euphorbia*[76], which we had no opportunity of seeing. . . . There is a caterpillar which produces a very large moth, and is found commonly on the *mimosa nilotica*. These are found in great plenty, often stripping the trees of all their leaves, and of them the Hottentots make many a delicious meal"[77]. They found here only few plants, but those which they came across, were all new. MASSON did not see a single *Erica* or *Protea* in the whole country (p. 315).

MASSON ends his account of this journey by saying that they returned to Cape Town on December 28. This date is not quite correct, according to THUNBERG, who tells us in his narrative of the journey to the Rogge-

[74] *Aloe dichotoma*, L. f., the Kokerboom, also found in Namaqualand.

[75] *Antidorcas marsupialis marsupialis*, Springbuck, Springbok.

[76] We can only guess the identity of this *Euphorbia*. The most likely species is *E. virosa*, Willd., the Noorsdoring, discovered near the Orange River by WILLIAM PATERSON in 1778. The latex which is extremely poisonous, was formerly used by the Namaqualand Bushmen and Hottentots as an arrow poison. The name *virosa*, venomous, is quite appropriate.

[77] Presumably *Gynanisa maia* (Saturniidae), a giant moth measuring $5\frac{1}{2}$ inches across the wings, whose caterpillars are known to feed on the leaves of *Acacia karroo* (Mimosa nilotica).

veld in his *Travels* (Vol. II, p. 184), that he arrived safe and sound at the Cape on the *29th* of December[78].

MASSON sailed for his home country soon after SPARRMAN met him in March, 1775[79]. He was to stay in England until May 19, 1776, when he left the country on another errand.

The Banksian Correspondence includes a *Memorandum*, not dated[80], addressed to the King by Sir JOSEPH BANKS, in his capacity as President of the Royal Society. It deals with MASSON's first mission to the Cape, and his achievements in the years 1776–82, and was later published in BRITTEN's paper on MASSON[81]. BANKS's *Memorandum* being so closely connected with MASSON's first visit to the Cape—it provides a good deal of additional information—we think it justified to produce it here in full, with exception, however, of the two accounts of expenses (the second one very elaborate) *re* MASSON's later missions to the various islands above mentioned, which are of less interest to the South African reader. The *Memorandum* reads as follows:

"In the year 1772 Sr. John Pringle, late President of the royal Society, made application to his Majesty that Mr. Masson, then one of the under Gardiners at Kew, might be appointed to reside for some time at the Cape of Good Hope, in order to collect there Seeds & living plants, for the Royal Botanical Garden at Kew.

His Majesty, being graciously pleased to honor this plan with his royal approbation, & to signify to Sr. John Pringle that Mr. Masson would be allow'd his expences, provided they did not exceed £200 a year, & a recompence on his return of £100 a year, Mr. Masson sail'd for that place, & was absent from England about 3 years.

In the course of his absence he drew bills on Messrs. Thos. Coutts & Co. to the amount, as appears by their books, of £583 8s. 6d. for his support & expences; & soon after his return his Majesty was pleased to order the sum of £300 to be paid to him, which money Mr. Aiton, his Majesties Botanical Gardiner, received from the hands of Mr. Ramus, deceas'd, late his Majesties first page, & paid to Mr. Masson, who gave a receipt for it as having recd. it from Mr. Ramus.

In the course of this Voyage Mr. Masson collected & sent home a profusion of Plants, unknown till that time to the Botanical Gardens in Europe, a full account of which will appear in Mr. Aiton's Catalogue of the Plants in the Royal Botanick Gardens at Kew, which is nearly ready for publication; by means of these, Kew Garden has in great measure attained to that acknowleg'd superiority which it now holds over every

[78] See also this Journal, Vol. V, Oct., 1939, p. 151.
[79] See this Journal, Vol. XXIII, April, 1957, p. 56.
[80] This must have been written either in 1782 or in 1783. See footnote 84.
[81] J. BRITTEN, Journal of Botany, Vol. XXII, 1884, pp. 115–17.

similar Establishment in Europe; some of which, as Trianon, Paris, Upsala, &c., till lately vyed with each other for preeminence, without admitting even a competition from any English Garden.

Mr. Masson, having by these means ingratiated himself with all those who make natural history their study or amusement, & produced an account of his voyage into the inland of Africa, which was printed in the Philosophical transactions, express'd the most ardent desire of being again employ'd in the like researches. Accordingly Sr. John Pringle again petition'd his Majesty in the year 1776, who was graciously pleas'd to consent to Mr. Masson's again undertaking an extensive Plan of operations; he was to visit *Madeira*, the *Canaries*, the *Azores*, and by the way of the *West Indian Islands*, to penetrate, if possible, to the *Spanish Main*.[82]

This he undertook, & succeeded, at least as fully as before, in sending home from Madeira, Teneriff, & the Western Islands [Azores], in a manner, the whole of their produce, the greatest part of which prov'd new to European botanists.

Ample mention is made of these Plants, dried specimens of which he communicated to the late Professor Linnaeus, in a work published by his Son, intitled ['Supplementum Plantarum'].

When Mr. Masson arriv'd in the West Indian Islands, the war [with France!], then somewhat advanced, made it necessary for him intirely to drop his plan of visiting the Spanish Main, to which it was in vain for him to apply for a pasport. The Islands themselves he found in so unsettled a state that it was with the utmost difficulty he found means to send home what he collected, parts of which were frequently lost by capture or waiting for Convoy.

When the French attack'd Granada[83] he was call'd upon to bear arms in its defence, which he did, & was taken prisoner fighting in the trenches.

He was also in the terrible hurricane of Octr. 14, 1780, at *St. Lucie* [St. Lucia], and lost there all the Collections at that time in his possession, & great part of his Clothes & Papers.

Finding by fatal experience that in time of war the purposes of his Mission could not effectually be fulfilled, he came to the resolution of returning, which he did in November of last year"[84].

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[82] The "Spanish Main": S. and/or W. shores of the Caribbean Sea.

[83] Granada, usually spelled Grenada, is one of the smaller West Indian Islands, like St. Lucia, mentioned below.

[84] We failed to find the year of MASSON's return home from the West Indian Islands. This is a pity, otherwise we would have known the year in which BANKS's *Memorandum* was written. From another more detailed account of expenses for the period 1776–82 it is learnt that the last of the W. I. Islands MASSON visited was Jamaica, and that he was there in March, 1781. The next item on the account is MASSON's passage home, but without a date.

After an account of expenses and salary from April, 1776, to April, 1782, Banks continues: "Having thus brought Mr. Masson home from ten years employment in Collecting plants for the Royal Botanick Garden at Kew, I cannot omit saying that during that time he has prov'd himself sufficiently instructed in the Science of Botany for the purposes of his Mission, & indefatigable in the execution of his duty.

I am confident that the famous Journey to the Levant, made by Monsr. Tournefort by the order of Lewis XIV [Louis!] at an immense expence, did not produce so great an addition of Plants to the Paris Gardens as Mr. Masson's Voyage to the Cape only has done to that of Kew.

As far as I am able to judge, his Majesties appointment of Mr. Masson is to be accounted among the few Royal bounties which have not been in any degree misapplied.

At present the War in Europe making it necessary for Ships from all parts of his Majesties dominions to come home in Convoy, almost precludes the Idea of Mr. Masson being employed with success in any part of the world.

Should his Majesty be graciously pleas'd to consider his past services, & those he is likely to perform when a peace shall arrive, to appoint such part of his salary as to his Royal wisdom shall seem meet for his present sustenance, & that he having by ten years absence from the improvements of his Profession, & by being during all that time admitted to the Society of Men of Education, as well as circumstances much superior to his own in great measure incapacitated from following it.

Should his Majesty, I say, be graciously pleas'd to appoint him a part of his Salary for his present sustenance, annexing him in this manner to the service of the Royal Botanick Garden, and to order him out again as soon as those concern'd in the management of it can find a proper opportunity, I am confident that such his royal bounty would conciliate the gratitude of all who make the Science of nature their study throughout Europe, & more especially those who in this Kingdom, I may say under his Majesties particular Auspices and protection, follow that most engaging occupation of glorifying the Creator by observing and pointing out the wonders of his works." Signed: J. Banks.

This is followed by another account of expenses over the period 1776–82 (see footnote 84).

During his stay, in 1777, on the Azores, he forwarded plants and specimens to Aiton, and a short but interesting view of the main island of St. Miguel [San Miguel] in the Philosophical Transactions[85]. In an

[85] Phil. Trans., Vol. lxviii, 1778, pp. 601–10.

essay *History of the Azores, or Western Islands*, in The Quarterly Review[86], there is a short reference to MASSON and his work. The author says: "No naturalist, except MASSON, and his knowledge was principally confined to botany, has yet visited them with a view of inquiring into their natural History . . . " (follows a reference to MASSON's publication in Phil. Trans.). From his description of the island of Fayal, next to San Miguel, we may quote: " . . . and the ever verdant *Faya*, from which the island derives its name. This beautiful plant, the only one of the arborescent kind common to these islands and Madeira, is described by MASSON in the Hortus Kewensis under the name of *Myrica Faya*[87].

After his return from the West Indian Islands, MASSON remained at home till 1783, when he was dispatched to Portugal. He did a good deal of collecting here, and also in Spain, including Gibraltar. During the same year he found his way across to the African continent, sending BANKS plants from Tangier and Sallee. Then he returned to Portugal, whence he sailed for Madeira (his second visit to the island). In 1785 he returned to England, but this time he was not to stay very long at home: the year had not yet passed when he was sent on another mission abroad.

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[86] The Quarterly Review, Vol. XI, 1814, pp. 194 and 197.

[87] *Myrica faya*, Ait., a 9½—16 feet high arborescent shrub (Myricaceae), mistaken by FORSTER for a beech (the word "faya" is the Portuguese for beech).

(*To be continued*)

THE VEGETATION OF THE FRESHWATER SWAMPS OF INHACA ISLAND

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ABSTRACT

A comparative account is given of the inland freshwater swamps of Inhaca Island, Moçambique. The vegetation is described in general terms and information is given as to the reaction and chloride content of the water and soils of the swamps.

The effects of human activity are described, for it is chiefly due to these influences that the swamps owe their most characteristic features and can no longer be considered to be in a natural condition.

The zonation of the swamps and their surrounds is remarkably uniform. A central zone of open water occupied by *Typha australis* Schum. et Thonn. or *Phragmites communis* Trin. is surrounded by a mixed community of amphibious herbaceous plants. This is in turn enclosed by grassland, which gives way at the outer edges of the swamp to forest. A striking feature is the small number of species present and the almost total absence of truly aquatic plants.

The swamps have no surface drainage. In all cases the chloride content is very low. The water is only slightly acid or even alkaline, but there is a very sharp increase in acidity in the surrounding soil.

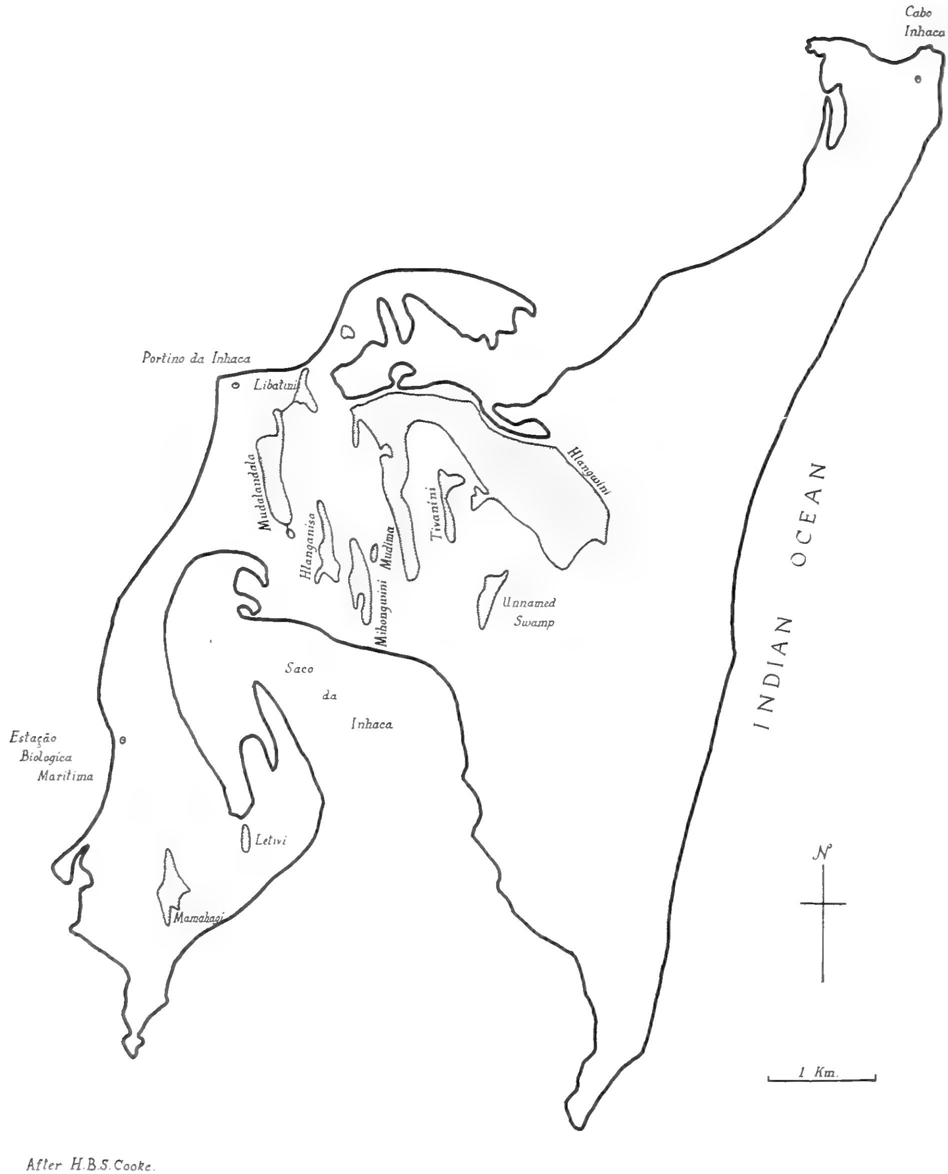
The conclusion is reached that these swamps may be justifiably classified as fens.

INTRODUCTION

Comparatively few accounts exist of the phanerogamic vegetation of freshwater communities of Southern Africa, particularly with respect to tropical or sub-tropical regions. This description of the swamps of Inhaca Island is therefore presented as a contribution towards a more detailed and systematic knowledge of the plant communities of the sub-continent.

Inhaca lies on the 26th parallel, some thirty-five kilometres east of Lourenço Marques. It is therefore in the sub-tropical zone.

The interior of the island is dissected by a complex series of sandy hill ridges, running chiefly in a north-south direction. Many of the valleys between these ridges are occupied by swamps, though the area of open



After H.B.S. Cooke.

FIG. 1.—Map of Inhaca Island, Showing the Position of Freshwater Swamps (Stippled)

water is very restricted. The altitude of the swamps is just above or below ten metres above sea-level. Most of the swamps have Ronga names but some are apparently unnamed.

The swamps are very similar in appearance and general features, but show interesting minor differences of ecology. Nearly all are completely landlocked but, in view of the sandy substratum, the possibility of subterranean drainage cannot be overlooked. The fact that the swamps are established on sand, which indeed covers most of the island, is also a feature of particular interest.

There is little doubt that the swamps are drying up. Mogg (in Moss and Macnae, 1958), describes this process as it has taken place since 1922.

The freshwater swamps are all very strongly influenced by human activity, and the interaction of the vegetation with the biotic factor was most striking in all the swamps examined. The greatest effects are due to the intensive cultivation of the borders of the swamps. The swamp water is utilized for irrigation and to this end channels are cut back into the land surrounding the swamps. Cultivation is carried out right to the edge of the open water of the swamps, so that there has been extensive clearance of the natural marginal vegetation. Old, dried-up swamps are almost entirely under cultivation. Nevertheless, in the wetter places, semi-aquatic vegetation readily re-colonizes unattended or abandoned land, and it is only by constant attention that the ground can be kept clear.

A further important factor is the use of *Imperata cylindrica* (L.) Beauv. for thatching. Many of the swamps are regularly fired to promote the growth of this grass. Having a deeply buried rhizome, it is not killed by the process and regenerates readily.

There are very few livestock on the island and these do not bring about any marked modification of the swamp vegetation. The extensive marginal trampling which is a common feature of swamps and vleis in Southern Africa is here altogether absent. Moreover the gathering of water by the native population of the island results only in the trampling of quite localized areas. In many cases special water holes are dug at the sides of the main swamps so that the latter are unaffected by water gathering.

DESCRIPTION OF THE SWAMPS

1. The Mamahagi Swamp.

This swamp is situated in a wide shallow basin amongst low sand hills. The zonation of the swamp is very conspicuous, comprising the following regions with their associated plant communities:

(*a*) Phragmitetum—Typhetum, in deep water.
(*b*) Shallow open water with few plants.
(*c*) Fringing zone of low-growing reed-swamp plants.
(*d*) Zone of grass associations or cultivation.
(*e*) Forest margin.

The plant communities are remarkably pure and have sharp boundaries.

The centre of the swamp is dominated by *Phragmites communis* Trin., standing in fairly deep water. In parts *Typha australis* Schum. et Thonn. is a co-dominant, but particularly at the northern end and around the outer fringes of the *Phragmites* it occurs as pure stands. The *Typha* and *Phragmites* deposit a litter of dead leaves which are slow to decay and form a thick and stable mat in the shallow water around the edges of the community. This mat encroaches on a region of open water of variable width. The following species were found in this zone and as occasional associates of the Phragmitetum-Typhetum: *Albizzia versicolor* Welw., *Euthalia conyzoides* L. (drier parts), *Hibiscus surratensis* L., *Rhus cf. pyroides* Burch., *Pentodon pentander* (Schum.) Vatke, *Pycreus mundtii* Nees, *Ricinus communis* L., *Blumea caffra* (DC.) O. Hoffm., *Hydrocotyle bonariensis* Lam., *Phyla nodiflora* (L.) Greene, *Nidorella auriculata* DC., *Polygonum acuminatum* H.B.K. var. *capense* Meisn.

The marginal zone of open water is continuous with several ditches which radiate outwards from the swamp. These ditches are water-filled at their inner ends but become progressively shallower and eventually completely dry as they leave the vicinity of the swamp. The following is a list* of the species which occur in the ditches, in order of decreasing wetness:

(*a*) Water up to 46 cm. deep: *Blumea caffra* (DC.) O. Hoffm. (*a*), *Erigeron canadensis* L. (*a*), *Phyla nodiflora* (L.) Greene (*o*), *Veronica anagallis-aquatica* L. (*o*).
(*b*) Water up to 15 cm. deep: *Phyla nodiflora* (L.) Greene (*a*), *Nidorella auriculata* DC. (*f*), *Polygonum acuminatum* H.B.K. var. *capense* Meisn. (*f*).
(*c*) Saturated soil: *Imperata cylindrica* (L.) Beauv. (*a*), *Pentodon pentander* (Schum.) Vatke (*a*), *Fimbristylis ferruginea* Vah.. (*f*), *Euthalia conyzoides* L. (*r*).
(*d*) Soil dry but liable to flooding: *Cryptolepis obtusa* N.E.B. (*a–d*), *Centella coriacea* Nannfd. (*a*), *Pycreus mundtii* Nees (*a*), *Erigeron canadensis* L. (*f*.) *Dactyloctenium gemminatum* Hack. (*f*).

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* Throughout this account the following symbols are used to denote frequency: *d*=dominant, *a*=abundant, *f*=frequent, *o*=occasional, *r*=rare, *v.r.*=very rare.

The outermost zone of the swamp is dominated by grasses and small herbaceous plants. This is well developed only on the western side, elsewhere being extensively cultivated. The following grasses occur in this zone: *Dactyloctenium aegyptum* (L.) Beauv., *Digitaria milanjiana* (Rendle) Stapf., *Eragrostis ciliaris* (L.) R. Br., *Ischaemum arcuatum* (Nees) Stapf. and *Panicum lavaefolium* Hack. *Panicum* is particularly abundant within the shade of the forest margin whilst in wet places *Ischaemum* occurs almost to the exclusion of other species. Other associates of the grass zone are *Asystasia gangetica* (L.) Anders., *Agathisanthemum bojeri* Klotzsch., *Centella coriacea* Nannfd., *Commelina nudiflora* L., *Cryptolepis obtusa* N.E.Br., *Cyperus sphaerospermus* Schrad., *Lobelia senegalensis* L., *Dicerocaryum zanguebarium* (Lour.) Merrill, *Smilax kraussiana* Meisn., *Sonchus oleraceus* L. and *Coccinia rehmannia* Corme. (forma).

The effects of cultivation are clearly shown in the grassland and cleared forest at one side of the swamp, some recently brought into use but elsewhere lying disused and rapidly becoming recolonized by a flora of ephemerals, followed by a strong invasion of swamp and forest species. Radiating out from the swamp are a number of irrigation ditches, some being natural drainage channels which have been deepened whilst others are entirely artificial. The presence of these carries outliers of the swamp vegetation across the dry sandy cultivated areas, and serves to furnish a ready supply of stolons and rhizomes for marginal infestation of these areas. The following species were collected from the cultivated land at the side of the Mamahagi Swamp: *Digitaria milanjiana* (Rendle) Stapf (*a*), *Digitaria swazilandensis* Steut. (*a*), *Eragrostis ciliaris* (L.) R. Br. (*a*), *Fimbristylis exilis* (R. Br.) R. et S. (*a*), *Perotis patens* Gaud. (*a*), *Rhynchelytrum repens* (Willd.) Hubb. (*a*), *Brachiaria humidicola* (Rendle) Schweik. (*a*), *Dipcade viride* (L.) Moench. (*f*), *Erigeron canadensis* L. (*f*), *Phyllanthus delagoensis* Hutch. (*f*), *Centella coriacea* Nannfd. (*o*), *Cyperus tenax* Boek. (*f*), *Sesamum alatum* Thonn. (*o*), *Cassia mimosoides* L. (*o*), *Dicerocaryum zanguebarium* (Lour.) Merrill (*o*), *Cyperus sphaerospermus* Schrad. (*r*), *Helichrysum kraussii* Sch. Bip. (*r*), *Lobelia senegalensis* A. DC. (*r*), *Oxygonum delagoense* O. Kuntze (*r*), *Triumfetta rhomboidea* Jacq. (*r*), *Vernonia poskiana* Vatke (*r*), *Brachiaria deflexa* (Schum.) C. E. Hubb. ex Robyns (*v.r.*), *Crotalaria lanceolata* E. Mey. (*v.r.*), *Hermannia modesta* (Ehrenb.) Manch. (*v.r.*), *Hyparrhenia dissoluta* (Nees) Hubb. (*v.r.*), *Merremia tridentata* (L.) Hall. f. (*v.r.*), and *Nidorella auriculata* DC. (*v.r.*).

On the north-west facing side of the swamp, on dry sandy soil, there is an invasion by *Helichrysum kraussii* Sch. Bip. The site is one of abandoned cultivation and the soil is loose and devoid of humus. *Helichrysum kraussii* Sch. Bip. forms small shrubs 30 to 60 cm. in height scattered at 60 to 90 cm. intervals. Thus whilst the plants are young

the soil is quite exposed. Later a closed canopy of *Helichrysum* is formed in many places, but even then the soil is quite unstable until an undergrowth of other shrubs and also small trees becomes established. Elsewhere on the island the remaining stages of the succession may be seen, where there is regeneration to natural scrub forest. The herbaceous associates of *Helichrysum kraussii* at the Mamahagi Swamp are: *Cyperus tenax* Boeck. (*a*), *Fimbristylis exilis* (R. Br.) R. et S. (*a*), *Indigofera preladoi* Harms. (*f*), *Dactyloctenium aegyptum* (L.) Beauv. (*r*), *Dicerocaryum zanguebarium* (Lour.) Merrill (*r*). *Rhynchelytrum repens* (Willd.) Hubb. (*v.r.*) and *Urochloa stolonifera* (Goosens) L. Chipp. (*v.r.*).

The swamp is surrounded by forest which forms a sharp boundary to the grassland and cultivated areas. The commonest species of the forest margin are: *Albizzia gummifera* (Gmel.) C. A. Sm., *A. versicolor* Welw., *Chrysanthemoides monolifera* (L.) T. Norl., *Oncoba kraussiana* Planch., *Conopharyngia elegans* (Stapf.) Stapf., *Strychnos spinosa* Lam., *Phoenix reclinata* Jacq., *Trichilia roka* (Forsk.) Choiv. and *Syzygium cordatum* Hochst., with *Cissampelos pareira* L. climbing over the outermost shrubs.

The soil of the swamp margin, though sandy, is rich in humus and of a dark colour whilst the surrounding regions have a soil which is highly leached and almost white. There is a sharp increase in acidity in passing from the wet to the dry soil, as is shown in Table I.

The water of the swamp is faintly brak but, as would be expected from its very light and sandy nature, no chloride could be detected in the surrounding soil.

TABLE I

REACTION AND CHLORIDE CONTENT OF SOIL IN THE MAMAHAGI SWAMP.

Origin of Sample	pH	Chloride
Centre of swamp (water sample)	8·0	42 p.p.m.
Edge of Typhetum; soil black and sticky, lying under 0·3 m. of water	8·0	29 p.p.m.
5·5 m. from edge of water: soil black in colour and sandy; cultivated	6·6	absent
11·0 m. from edge of water; soil light brown in colour, sandy and moist; cultivated	5·9	absent
16·5 m. from edge of water; old cultivated soil	5·9	absent
Ischaemetum: old cultivated land	5·8	absent
23·8 m. from edge of water; soil very light brown in colour, of loose sand. Forest margin	5·6	absent

All chloride determinations were carried out by Best's electrometric method. Soil and water reaction was determined in the field by the method of Kuhn.

2. Western Arm of Hlangwini Swamp.

The centre of the swamp is occupied by a pure stand of *Typha australis* Schum. et Thonn. This is surrounded by a zone in which *Typha* is still dominant but has amongst it scattered plants of *Phragmites communis* Trin. This is in turn enclosed by co-dominant *Typha* and *Phragmites* with a conspicuous under-storey of *Polygonum acuminatum* H.B.K. var. *capense* Meisn. and *Melanthera scandens* (Schum. et Thonn.) Brenan., the latter reaching a height of about four feet above the water surface. The swamp is surrounded by a marginal ditch, a very constant feature of the Inhaca swamps, in which flourishes a luxuriant herbaceous vegetation. In this case there is some thinly scattered *Phragmites* and a thick carpet of *Dryopteris gongylodes* (Schk.) Ktze. In some parts of the swamp the latter occurs pure, in other parts *Commelina, Jacquemontia tamnifolia* (L.) Griseb. and *Pentodon pentander* (Schum.) Vatke are associated with it. On the drier side of the ditch, that is, away from the main body of the swamp, *Panicum maximum* Jacq., *Hydrocotyle bonariensis* Lam., *Imperata cylindrica* (L.) Beauv. and *Helichrysum foetidum* (L.) Cass. occur.

The west side of the swamp is bordered by cultivated land, but the east side shows typical marginal grassland up to the edge of the forest. This grassland includes *Ischaemum arcuatum* (Nees) Stapf., *Cassia mimosoides* L., *Cyperus sphaerospermus* Schrad. and *Imperata cylindrica* (L.) Beauv.

3. The Mudalandala Swamp.

This is a large swamp dominated by *Typha australis* Schum. et Thonn. with no *Phragmites* present. Of particular interest is the occurrence of *Cyperus papyrus* L. which is found nowhere else on the island. The *Typha* grows right up to the edge of the marginal ditch and extends in a rather scattered fashion up to the lateral ditches.

The land surrounding the swamp is cultivated, but there remains the characteristic narrow wet zone fringing the swamp itself. Aquatic vegetation extends for about twenty to forty feet up the radiating side ditches. This includes *Commelina nudiflora* L., *Dryopteris gongylodes* (Schk.) Ktze., *Torenia thouarsii* (Cham. et Schlecht.) Kuntze, while in the drier parts further from the swamp *Hydrocotyle bonariensis* Lam., *Lobelia senegalensis* A. DC., *Pentodon pentander* (Schum.) Vatke and *Polygala rehmanni* Chodat. are found.

The main swamp drains northwards towards the sea by way of a narrow marshy stream. The centre of this stream is occupied by *Typha australis* Schum. et Thonn. On either side is an inner zone of *Dryopteris gongylodes* (Schk.) Ktze. and an outer zone of *Cyperus aequalis* Vahl.,

both with associated *Polygonum acuminatum* H.B.K. var. *capense* Meisn.

The narrow swamp just described widens out into the Libatini Swamp which lies near to the coast. It is occupied almost entirely by *Phragmites communis* Trin.

The south end of the Mudalandala Swamp shows the following structure: The central part is occupied by *Typha australis* Schum. et Thonn. with an understorey of *Dryopteris gongylodes* (Schk.) Ktze. and *Polygonum acuminatum* H.B.K. var. *capense* Meisn. There is a marginal zone in which *Dryopteris* is dominant. Associated species are *Polygonum acuminatum* H.B.K. var. *capense* Meisn., *Cyperus aequalis* Vahl., *Jussiaea pilosa* H.B.K. and a little *Typha australis* Schum. et Thonn. A wide ditch forms the edge of the swamp in this region. The inner, wetter side is dominated by *Cyperus aequalis* Vahl. with occasional *Xyris anceps* Lam. and *Commelina diffusa Burm f.* whilst the outer side of the ditch, which borders on sandy cultivated land, bears *Imperata cylindrica* (L.) Beauv. as a dominant, and *Gomphocarpus fruticosus* (L.) Ait., *Eriosema parviflorum* E. Mey. and *Torenia thouarsii* (Cham. et Schlecht.) Ktze., which is confined to the upper edge of the ditch.

The water of the swamp has a pH of 4·6 and a chloride content of 4 p.p.m.

4. Unnamed Swamp.

This is a large swamp lying in a wide shallow valley between the hills to the north-east of the Saco. The southern end is extensively cultivated, with little square patches of mannihot cut out from the swamp and irrigated by a complicated system of ditches. Twelve hours after rain these ditches remained full of water and the surrounding soil was saturated in spite of its loose sandy nature. These patches of cultivation are of different ages, the most recently developed having a thin cover of ephemeral weeds whilst the older have been recolonized by swamp vegetation, notably *Ischaemum arcuatum* (Nees) Stapf. and *Pentodon pentander* (Schum.) Vatke.

The swamp is completely surrounded by rising ground which bears forest or forest remnants and broad tracts of grassland.

A small area at the south end of this swamp is still in a fairly natural condition, with open water. This is probably the remnant of a much larger swamp. The dominant species are *Typha australis* Schum. et Thonn., *Dryopteris gongylodes* (Schk.) Ktze. and *Polygonum acuminatum* H.B.K. var. *capense* Meisn. Around the edge of this small area are found *Ischaemum arcuatum* (Nees) Stapf., *Imperata cylindrica* (L.) Beauv., *Cyperus isocladus* Kunth., *Gomphocarpus fruticosus* (L.) Ait., *Fuirena*

chlorocarpa Ridl. and *Nymphaea capensis* Thb. There is the usual water-filled ditch which leads off into channels between raised islands of cultivation or *Ischaemum.*

The greater part of the main swamp, that is the large area north of the Typhaetum and cultivated plots, is covered by a dense sward of *Ischaemum*, with occasional plants of *Cyperus obtusiflorus* Vahl. and *Periglossum mossambicense* Schltr.

The water of the *Typha* swamp has a reaction of pH 7 and a chloride content of 7 p.p.m. The Ischaemetum is developed in waterlogged, black sandy soil with a pH of 6·4 and a chloride content of 3 p.p.m. The much drier soil at the outermost edge of the Ischaemetum has a pH of 5·7 but contains no detectable chloride.

5. The Mihongwini Swamp.

This swamp is situated in a rather steeper-sided bowl than the others but still has the usual marginal forest followed by grassland or cultivated plots surrounding the swamp proper.

The central part of the swamp is occupied by pure *Typha australis* Schum. et Thonn. growing in fairly deep water. A very well-marked zone of herbaceous dicotyledons grows in the shallow water at the edge of the swamp. It contains scattered plants of *Typha* and in addition the following species are present: *Triumfetta pilosa* Roth., *Dryopteris gongylodes* (Schk.) Ktze., *Polygonum acuminatum* H.B.K. var. *capense* Meisn., *Melanthera scandens* (Schum. et Thonn.) Brenan, *Fuirena chlorocarpa* Ridl., *Psoralea, Torenia thouarsii* (Cham. et Schltr.) Ktze., *Pentodon pentander* (Schum.) Vatke, *Euthalia conyzoides* L. and *Ischaemum arcuatum* (Nees) Stapf., the latter rather sparse and very tall when growing in water.

There is a second zone of herbaceous plants outside the inner one, and this is readily recognizable not only because of a distinct species list but also by the much drier substratum. It is occupied by *Ischaemum arcuatum* (Nees) Stapf., *Hydrocotyle bonariensis* Lam., *Imperata cylindrica* (L.) Beauv., *Torenia thouarsii* (Cham. et Schltr.) Ktze. and *Cassia mimosoides* L. *Limeum viscosum* s.sp. *viscosum* var. *kraussii* occurs in the damp borders of the cultivated land. There follows then what may be described as the dry Ischaemetum with *Eriosema parviflorum* E. Mey. and *Fuirena.*

At one side of the swamp the marginal ditch is absent, and here one can see what may well be the more natural border of these swamps. A zone occurs dominated by *Dryopteris gongylodes* (Schk.) Ktze. with which are associated scattered *Typha, Polygonum acuminatum* H.B.K. var. *capense* Meisn. and *Melanthera scandens* (Schum. et Thonn.) Brenan.

These plants form a raised mat, where the soil is waterlogged but not submerged.

As in most parts of the island, the soil of the surrounding cultivated land is of very loose leached sand, with *Gisekia pharnaceoides* L. occurring frequently. The soil reaction and chloride content bear a similar relationship to the proximity of the wet part of the swamp that they do elsewhere. Thus the swamp water has a pH of 6·6 and chloride content of 13 p.p.m. Soil from the emersed *Dryopteris* zone has a pH of 5·7 and chloride content of 3 p.p.m., whilst similar measurements for the dry Ischaemetum are pH 5 and chloride content 1 p.p.m.

The Mihongwini Swamp has no free-floating or floating-leaved specimens, possibly due to the shading and overcrowding by the tall reed swamp plants. The swamp shows marked vertical stratification. Thus the dominant *Typha australis* Schum. et Thonn. rises to a height of about 2·7 m. above the submerged mud surface. *Dryopteris* and *Polygonum* form a fairly open canopy beneath the *Typha*. The depth of water varies, but in general the submerged parts of the reedswamp plants are enclosed by dead leaves in different stages of decomposition. These not only float on or just below the surface, but remain entangled with the growing stems to form a continuous loose mat to the bottom.

As has been indicated, there is no marginal ditch in some parts of the Mihongwini Swamp, and under these circumstances a mat of vegetation forms above the water. Even on moderately moist soil there is similar stratification and there is formed a dense cushion, 90—120 cm. thick, of living and non-living stems and leaves of *Dryopteris*, *Polygonum* and *Cyperus sphaerospermus* Schrad. The latter is dominant and contributes towards knitting together the cushion of vegetation by virtue of its stoloniferous and viviparous mode of growth. The ground beneath is covered by a thick layer of brown, semi-humified débris. It has a reaction of pH 6·8 and a chloride content of 7 p.p.m., so that in this respect it constitutes a substratum with greater affinities with the centre of the swamp rather than with the surrounding land. Though the surface is dry and firm enough to walk on, the water may be only one inch below. The soil underlying this litter is sandy, blackish brown in colour and sweet smelling, as contrasted with the malodorous black muddy sand found in the centre of all the swamps.

6. Hlanganisa Swamp.

Phragmites communis Trin. is the dominant plant of the deep water occupying the centre of the swamp, but there are pools and channels of open water in which grow one of the few floating-leaved aquatics which

occur on the island, *Nymphaea capensis* Thb. The Phragmitetum is surrounded by a marginal zone of vegetation on wet soil or in shallow water. This zone may be subdivided into distinct inner and outer regions. The former is dominated by *Phragmites*, with *Cladium jamaicense* Crantz. and *Dryopteris gongylodes* (Schk.) Ktze. as associates. In the outer zone *Dryopteris* becomes dominant and is accompanied by *Polygonum acuminatum* H.B.K. var. *capense* Meisn., *Melanthera scandens* (Schum. et Thonn.) Brenan. and a little scattered *Phragmites*. (Fig. 2.)

The swamp is bounded by a wide shallow ditch. The inner, swamp. side is occupied by the previously mentioned species of the marginal zone whilst the outer side, which comes under the influence of cultivation, carries a number of water-loving weeds very similar to those described from the Mamahagi Swamp. Ditches which traverse the cultivated areas also carry a water-tolerant flora, such as *Imperata cylindrica* (L.) Beauv., *Pentodon pentander* (Schum.) Vatke, *Erigeron canadense* L. and also *Helichrysum foetidum* (L.) Cass. for a limited distance.

The reaction and chloride content of the swamp water and soil is shown in Table II. Once again it will be noticed that there is an increase in acidity and a decrease in chloride in passing from the wetter parts of the swamp to the surrounding drier soil.

TABLE II

REACTION AND CHLORIDE CONTENT OF SOIL IN THE HLANGANISA SWAMP

Origin of Sample	pH	Chloride
Swamp water	8·0	22 p.p.m.
Inner marginal zone, soil	7·5	9 p.p.m.
Outer marginal zone, soil	7·5	4 p.p.m.
Ditch, submerged soil	7·0	2 p.p.m.
Ditch, top edge bordering cultivation	5·8	absent
Cultivated soil 3·7 m. from water	5·5	absent

7. South End of the Mudalandala Swamp.

At the south end of the Mudalandala is a small swamp which appears to drain into the main swamp, partially by way of a short stream but otherwise underground. The distance between the large and small swamp is about 275 m.

The water of the small swamp is very foul and the dominant vegetation consists of *Phragmites*. The zonation, extending from the stream at the north end, is as follows: There is a patch of pure *Dryopteris gongy-*

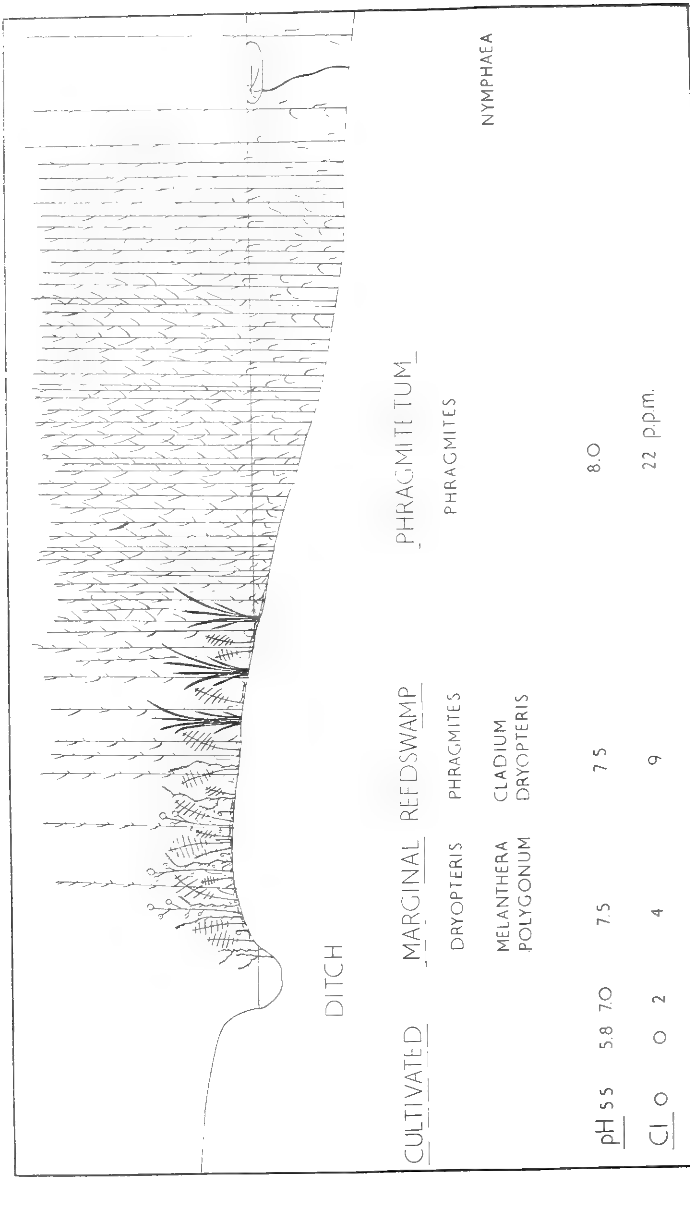

FIG. 2. Diagrammatic Section through the edge of the Hlanganisa Swamp.

lodes (Schk.) Ktze. followed by some *Phragmites* with scattered *Typha* and *Melanthera*. The central channel of open water contains a thin cover of *Phragmites*, with *Melanthera scandens* (Schum. et Thonn.) Brenan, *Polygonum acuminatum* H.B.K. var. *capense* Meisn. and *Imperata cylindrica* (L.) Beauv. On either side of this *Phragmites* is dominant though very thinly distributed. The wet marginal zone is present as in other swamps described, but it is not sharply demarcated. The water of this swamp has a pH of 7·4 and a chloride content of 28 p.p.m. A feature of particular interest is the presence of *Pteridium aquilinum* (L.) Kuhn. at the southern end. This plant at present extends to within 60 cm. of the outermost scattered *Phragmites*, though it is on sloping ground and does not reach very wet soil.

THE GENERAL FEATURES OF THE SWAMPS

The freshwater swamps of Inhaca Island are very uniform in structure. In all cases there is a central region of shallow water occupied by a reed-swamp community. There is an almost total absence of submerged aquatic plants, *Utricularia stellaris* L. f. being one of the few exceptions. *Nymphaea capensis* Thb. and *Lemna minor* L. are the only floating-leaved aquatics recorded, and even these have very sporadic distribution. As compared with the freshwater communities described from the Union of South Africa, the number of species recorded from the swamps of Inhaca is rather restricted, being about fifty species. The sparsity of species is undoubtedly due to shading of the water by the dominant or co-dominant plants. Though the water is not turbid and never more than faintly brown-tinged, the bottom is rich in humus and the water therefore almost certainly presents an oxygen-deficient habitat.

All the swamps are sited on sand but, except where cultivated, a considerable depth of sandy peat is developed. In most cases there is no free drainage. A characteristic feature is the presence of a peripheral water-filled ditch, artificially kept open. The Phragmitetum and particularly the Typhetum in the central region of the swamps is characterized by a mat of dead leaves. This forms a floating platform upon which it is possible to walk dryshod. This obviously is highly effective in preventing any illumination of the water beneath and deters any but the most vigorous competitor from becoming established.

In spite of apparently rather uniform conditions throughout the island, there is a remarkable dissimilarity between the floras of the different swamps. Thus *Nymphaea capensis* Thb. occurs in one swamp only, *Lemna minor* L. in one small water hole, *Phyla nodiflora* (L.) Greene and *Blumea lacera* DC. have been found only in the Mamahagi Swamp

and *Cladium jamaicense* Crantz. is equally local. *Cyperus papyrus* L. only occurs in the Mudalandala Swamp. *Glinus oppositaefolius* (L.) A. DC. has been collected from a single shaded water hole but not from any of the large swamps.

These differences are possibly due to the complete lack of communication between the swamps by means of streams or other forms of open drainage. The numerous and extensive swamps in the northern half of the island, though frequently much less than half a kilometre apart, are isolated from one another by sandy ridges covered by grass or forest or in other cases cultivated.

The accompanying diagram depicts the generalized structure of these swamps. (Fig. 3.)

There is little evidence of the natural sequence of succession, chiefly because of extensive cultivation of the margins of the swamps. Thus silting up is partially prevented and the swamps tend to assume a convex profile. There is little encroachment by the land vegetation and woody plants are very rare in the immediate vicinity of the swamps. Even *Phoenix reclinata* Jacq., which is frequent throughout the island, only occurs where the forest has been cleared from the edges of the swamps. A single plant of *Rhus. cf. pyroides*, some four feet in height, was found in the Mamahagi Swamp and there is in the same situation a large tree of *Ficus capensis* Thb. These are probably remnants of the boundary between the forest and the swamp.

The secondary sere can be seen in many places. With cessation of soil disturbance the ground in the vicinity of the swamps is invaded by *Ischaemum arcuatum* (Nees) Stapf., although this appears to be a plant of intermediate water tolerance, not being dominant where there is free water nor yet occupying very dry ground. A second system of succession involves the encroachment of forest upon the marginal cultivated land. *Helichrysum kraussii* Sch. Bip. is the forerunner of large shrubs and tree seedlings. *Anacardium occidentale* L. is abundant in the cultivated land around the swamps, and *Syzygium cordatum* Hochst. and *Strychnos spinosa* Lam. survive felling and are left undisturbed on drier ground. Most of the other invaders of cultivated land are those which are common throughout the island and only those in the immediate vicinity of ditches or the swamps show aquatic features.

There is some evidence to suggest that the swamps on Inhaca Island may be classified as fens, in the sense of the European ecologists (*vide* Tansley 1949). Very few fens have been described in Southern Africa, one example being the coastal lakes near Knysna (Martin 1956) which are much more typical and easily recognizable than those on Inhaca. An interesting comparison may be made with the swamps of Huleh,

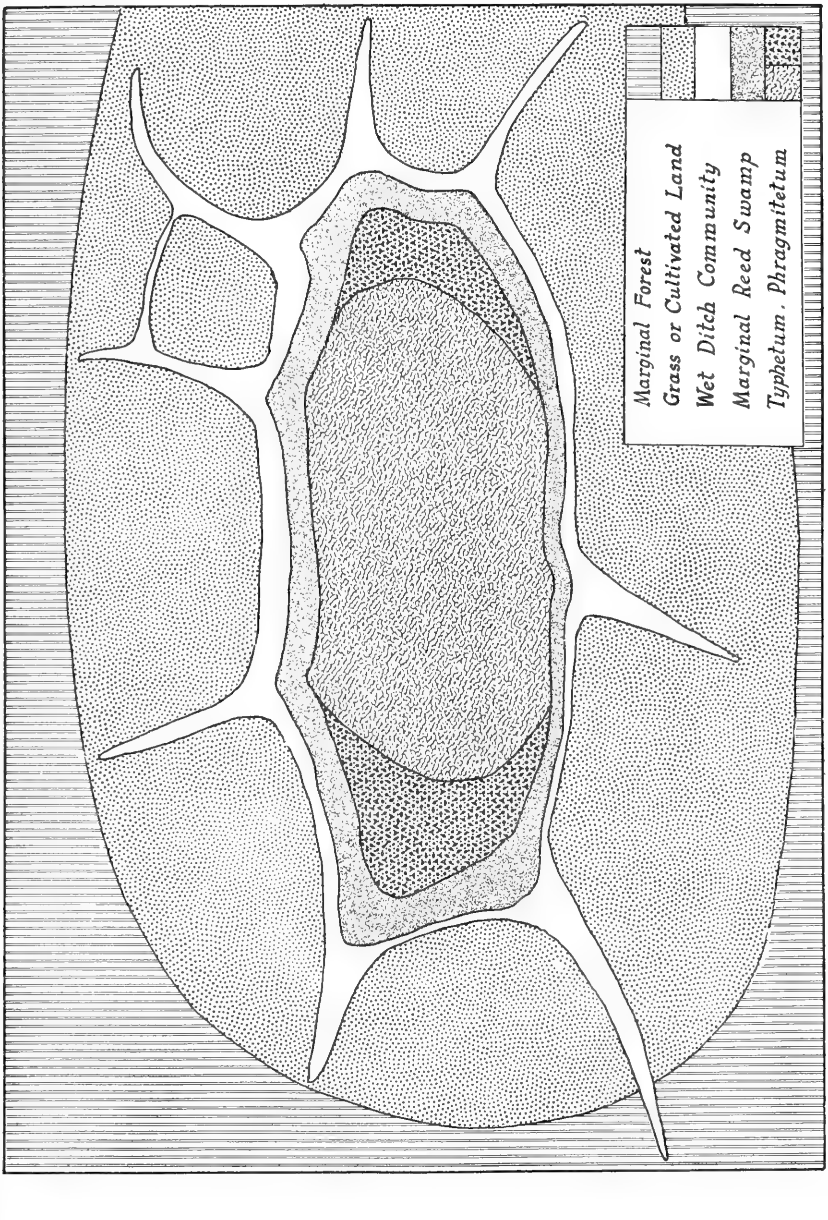

FIG. 3.—Diagrammatic Plan of a Freshwater Swamp on Inhaca Island. (Based on the Mamahagi Swamp.)

Palestine, described by Forbes Jones (1940). There one finds consociations of *Phragmites*, *Typha angustata* Bory et Chaub., *Cyperus papyrus* L. and *Cladium mariscus* R. Br. on alkaline peat. These are regarded as belonging to the fen type of association. The general morphology of these swamps and the species which occur there show many features in common with the Inhaca swamps.

Most of the swamps which have been investigated on Inhaca have water which is neutral or alkaline in reaction, only that of the Mihongwini Swamp being slightly acid and part of the Mudalandala being strongly acid. The soils of the marginal reedswamp also have a reaction that is in most cases not far from neutrality. The chloric contents of the waters are too low to account for any great excess of sodium ions so that one may suppose that the swamps receive calcareous leachate from the surrounding sandy soil. It is noteworthy that the swamps are devoid of halophytes, which might be expected to be associated with saline alkaline soils. Such plants, as for example *Chenopodium vulvaria* L., occur on the fringes of the nearby salt marshes.

Another feature which indicates fen affinity is the formation of neutral peat in the Mihongwini Swamp. The presence of a fringing vegetation of mixed reedswamp species, the marginal ditch of open water and the tendency towards the development of a convex profile to the edges of the swamps are characteristics which conform to general fen type of topography. Very little is known of the autecology of most of the species encountered in these swamps, but *Phragmites communis* Trin. and *Typha* spp. are common dominants of European fens and *Cladium mariscus* R. Br., which is considered to require a soil of at least pH 6 (Conway 1942) is, under north temperate conditions, a fen indicator. *Cladium jamaicense* Crantz. which occurs on Inhaca, is obviously closely allied to the European species and has only recently come to be regarded as distinct.

The swamps on Inhaca do not correspond exactly with any of those previously described from South Africa, though in most cases a comparison is only possible on a basis of the species lists for the different seral stages (Muir 1929, Phillips 1931, Dyer 1937, Louw 1951, West 1951). *Phragmites communis* Trin. appears ubiquitous and *Typha capensis* Rohrb. or *Typha australis* Schum. et Thonn. are constant associates. The interaction of *Phragmites* and *Typha* has been discussed by Phillips (l.c. p. 109) and Louw (l.c. p. 18) and observations at Inhaca confirm the mutual independence of these plants and their very variable behaviour. Either may form pure stands or become associated to any degree, including co-dominance. *Phragmites* seems to have a rather wider range, extending from deep to very shallow water or even wet soil.

The Inhaca swamps are in an advanced stage of development and, as compared with other swamps described from South Africa, the truly aquatic phase is poorly represented. The zones dominated by members of the Cyperaceae (Muir l.c. p. 70, Louw l.c. p. 21, Phillips l.c. p. 112) are absent. Apart from the few ubiquitous species mentioned above, the species list for the Inhaca swamps have very little in common with those recorded from South Africa, making comparison difficult. Thus *Dryopteris gongylodes* (Schk.) Ktze., which is so prominent on Inhaca, replaces *D. thelypteris* (L.) A. Gray, of South African swamps and *D. thelypteris* (L.) A. Gray, *D. cristata* (L.) A. Gray, etc., of European fens. Members of the Juncaceae are rare.

Thus the Inhaca swamps represent a definite type of community, differing from but yet having affinities with other hydroseres of the temperate regions of the northern and southern hemispheres. This general survey sheds some light on the autecology of certain sub-tropical species, the nature of their associates and their reaction to the biotic factor.

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A NEW ALOE FROM ERITREA

By G. W. Reynolds

(With Plates XVIII, XIX)

Aloe massawana Reynolds. Species nova, affinis *A. barbadensi* Mill. et *A. trichosanthae* Berger; ab *A. barbadensi* inflorescentia longiore pedicellis longioribus racemis brevioribus laxioribus, ab *A. trichosantha* racemis brevioribus, perianthio glabro differt.

Planta acaulis vel breviter caulescens, mox caespitosa. *Folia* ca. 16, dense rosulata, ca. 50 cm. longa, 10 cm. lata, 2 cm. crassa, sensim attenuata; *supra* pallide viridia, superne leviter canaliculata; *subtus* convexa; marginibus dentibus albidis 2—3 mm. longis, 15—25 mm. distantibus armata.

Inflorescentia 2—3-ramosa, 1·20—1·50 met. alta. *Racemi* anguste cylindrico-acuminati, 15—20 cm. longi, 5 cm. diametro. *Bracteae* anguste ovatae, 7 mm. longae, 3 mm. latae, albidae, scariosae, 5-nervatae. *Pedicelli* 6 mm. longi. *Perianthium* glabrum, pallide coccineum, cylindrico-trigonum, 30—32 mm. longum; *segmenta exteriora* per 12 mm. (interdum 15 mm.) libera, obscure 3-nervata, interiora latiora. *Antherae* 2 mm. exsertae. *Stigma* demum 3 mm. exserta. *Ovarium* 4—5 mm. longum, 2 mm. diametro. (Plates XVIII and XIX.)

Habitat: Eritrea, Massawa District: Arkiko, 8 miles south of Massawa, 13th April 1956, leaf only, Reynolds 8047 (PRE); plant ex Arkiko cult. Johannesburg, 4 May 1958, Reynolds 8047 (PRE). Plants cult. hort. Mr. A. J. Bell near Dar-es-Salaam, fl. 30 June 1958, Reynolds 8733 holotype (PRE), isotype (K, EA).

This new species was first brought to my notice by Professor H. B. Gilliland who, in January 1952, photographed flowering plants at Arkiko, 8 miles south of Massawa, in Eritrea. This locality is about 50—100 ft. above sea-level, at 15° 31′ N., 39° 26′ E., near the shore of the Red Sea.

Subsequently Mr. P. R. O. Bally informed me that he had found this species at Arkiko in April 1949, and also at the southern end of Zula Bay, further to the south, but none was then flowering.

When I investigated the Aloes of Eritrea in May 1956, I found many plants at Arkiko, and also in a dry sandy depression at Tumalo about

5 miles west of Massawa. No plants were then in flower, and I could not complete a description, but plants from Arkiko subsequently flowered in Johannesburg.

In July 1957 Mr. J. H. Whellan of Salisbury, Southern Rhodesia, and Mr. L. D. E. F. Vesey FitzGerald of Abercorn, Northern Rhodesia, found some Aloe plants "closely resembling *A. vera*" near the Inn-by-the-Sea, 16 miles north of Dar-es-Salaam in Tanganyika Territory. On 30 June 1958 I visited that locality and found the plants.

I also met Mr. A. J. Bell, and saw large numbers of this species flowering in his gardens at Ukutani, 21 miles north of Dar-es-Salaam. About 20 years ago Mr. Bell had found a group of these plants growing on an old Arab grave on his estate. He divided them up and cultivated the increases. It seems that all the plants now cultivated in the neighbourhood derived from the original plants on that grave. This species is not known anywhere else along the coast, and it is almost certain that it was introduced.

These cultivated plants are, without any doubt whatever, conspecific with those at Arkiko in Eritrea.

A. massawana is named after the district of Massawa in Eritrea, which appears to be the specific centre, and where considerable numbers are found wild.

In habit of growth and in leaf and rosette characters, *A. massawana* bears a striking resemblance to *A. barbadensis* Mill. (=*A. vera* "L" non Mill.), but the latter differs in having a shorter thicker peduncle, shorter pedicels, and longer denser racemes of yellow flowers.

In inflorescence characters, *A. massawana* is closely allied to *A. trichosantha* Berger, but the latter (which I saw in the Ghinda valley, about 44 miles west of Massawa) has longer racemes and tomentose perianths apart from very different leaves.

The description is based on plants near Massawa, and flowers of cultivated plants.

DESCRIPTION: *Plants* acaulous or with short stems, with numerous shoots at random forming large dense groups sometimes 2—3 met. across.

Leaves about 16, densely rosulate, suberectly spreading, about 50 cm. long, 10 cm. broad and 2 cm. thick at base, gradually narrowing to the apex; *upper surface* dull grey-green, flat low down, slightly canaliculate upwards, with or without a few dull white spots low down; *lower surface* convex, dull grey-green, with or without a few white spots low down; *margins* armed with soft to firm almost white teeth that are reddish brown at apex only, smaller and 10 mm. apart low down, longer (2—3 mm.) and more distant (15—25 mm.) upwards; *sap* dries yellow.

Inflorescence usually 3-branched and 120—150 cm. high.

PLATE XVIII. *Aloe massawana* Reynolds
Plants at Arkiko, 8 miles south of Massawa, Eritrea. Height 1·40 met.
Photographed by Professor H. B. Gilliland in January, 1952.

Plate XIX. *A. massawana* Reynolds.
Plants cultivated by Mr. A. J. Bell, near Dar es Salaam, Tanganyika Territory.
Height 1·40 met. Flowers 1/1 from bud to post-pollination stage.

Peduncle plano-convex and 20 mm. broad at base, terete upwards, 2—3-branched from about the middle.

Racemes narrowly cylindric-acuminate, the terminal the highest and 15—20 cm. long, 5 cm. diam., sublaxly flowered, youngest buds suberect and denser, open flowers laxer and nutant.

Bracts narrowly ovate-deltoid, 7 mm. long, 3 mm. broad, thin, scarious white, 5-nerved.

Pedicels 6 mm. long, obliquely spreading, decurved at apex.

Perianth pale scarlet, glabrous, 30—32 mm. long, cylindric, trigonous, 7 mm. diam. across the ovary, thence slightly narrowed on underside and enlarging slightly towards the throat with mouth slightly upturned; *outer segments* free for 12 mm. (sometimes 15 mm.), with white margins, obscurely 3-nerved, the apices subacute, slightly spreading; *inner segments* broader than the outer, with broad almost white border, with 3 crowded orange nerves forming a keel, the apices more obtuse and more spreading than the outer.

Filaments lemon, filiform-flattened, the 3 inner narrower and lengthening before the 3 outer with their *anthers* in turn exserted 2 mm.

Stigma at length exserted 3 mm.

Ovary pale green, 4—5 mm. long, 2 mm. diam.

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I am indebted to:

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The South African Council for Scientific and Industrial Research for travelling grants that enabled me to visit Eritrea in 1956, and Tanganyika Territory in 1958.

A NEW ALOE FROM TANGANYIKA TERRITORY

By G. W. Reynolds

(With Plates XX, XXI)

Aloe venusta Reynolds. Species nova, affinis *A. macrosiphoni* Bak., sed ita differt: folia non nitida, gemmae bracteis magnis carnosulis imbricatis obtectae, pedicelli longiores, perianthium brevissime pubescens.

Planta acaulescens. *Folia* c. 20, dense rosulata, arcuato-adscendens, c. 50 cm. longa, 9 cm. lata, sensim attenuata; *supra* viridula, copiose maculata, basi plana, superne leviter canaliculata; *subtus* convexa, copiose maculata; marginibus dentibus 3 mm. longis, 8—10 mm. distantibus armata.

Inflorescentia paniculata, c. 10-ramosa, 1—1·20 met. alta. *Racemi* cylindrico-conici, densi, 15—20 cm. longi. *Bracteae* ovato-cuspidatae, carnosulae, c. 11 mm. longae, 10 mm. latae, 7—9-nervatae. *Pedicelli* 13 mm. longi. *Perianthium* coccineum, brevissime pubescens, cylindrico-trigonum, 32 mm. longum, circa ovarium 7 mm. diametro; *segmenta exteriora* per 12 mm. libera. *Antherae* 2—3 mm. exsertae. *Stigma* demum 3—4 mm. exserta. *Ovarium* 6 mm. longum, 3 mm. diametro. (Plates XX, XXI.)

Habitat: Tanganyika Territory, Western Province, on rocks 71 miles south of Mpanda, 35 miles north of Namanyere, c. 7° 07′ S., 30° 58′ E., alt. 4,600 ft., fl. 20 July 1958, Reynolds 8948 holotype (PRE), isotype (K, EA).

Our new species was discovered by Dr. N. R. Smuts and myself on a rocky outcrop surrounded by woodland, half a mile east of the road at a point 71 miles south of Mpanda, 9 miles north of Chisi, and 35 miles north of Namanyere in the Western Province of Tanganyika Territory, at 4,600 ft.

It is nearest allied to *A. macrosiphon* Bak. which I have seen in numbers in the Kagera Valley near the boundary between Tanganyika Territory and Uganda, also west and south of Lake Victoria. Both *A. macrosiphon* and *A. venusta* have leaves copiously spotted on both surfaces, a more or less 10-branched inflorescence 1—1·20 met. high, racemes 15—20 cm. long, and cylindric-trigonous perianths 32 mm. long.

A. venusta differs in having leaves that are not glossy, leaf margins with a rather pronounced continuous pink cartilaginous edge, racemes

with the apical buds denser and hidden by large fleshy imbricate bracts, slightly longer pedicels, and perianths that are pale scarlet and minutely pubescent.

In *A. venusta* the leaves are arcuate-ascending, with the apices incurved and grouped rather closely together. The lower surface of leaves is thus more exposed to the sun than the upper.

In all inflorescences seen, the peduncle was erectly ascending until above the leaf apices, then curved somewhat suberectly with the upper portion again ascending.

A. macrosiphon grows almost invariably in shady thickets on termite mounds in bush or woodland, with the inflorescence usually entangled in bush, whereas *A. venusta* was found only in scanty soil on exposed rocks surrounded by Brachystegia-Isoberlinia woodland. Plants occur singly or in small groups and in an area infested with tsetse flies.

DESCRIPTION: *Plants* acaulous, solitary or in small groups.

Leaves about 20, densely rosulate, compactly arcuate-ascending, about 50 cm. long, 9 cm. broad at base, gradually narrowing to an incurved apex with the apices rather closely grouped together; *upper surface* flat low down, somewhat canaliculate upwards, dull grey-green, copiously spotted throughout, the spots elliptical, pale green, more crowded low down, more scattered upwards; *lower surface* rounded, reddish brown where exposed to the sun, copiously spotted throughout, the spots smaller, more numerous and more crowded than in the upper surface; *margins* sinuate-dentate, with distinct continuous pinkish edge armed with teeth of the same colour, the teeth deltoid, forward-uncinnate, 3 mm. long, 8—10 mm. apart at middle of leaf, smaller and more crowded low down, longer and more distant upwards.

Inflorescence a many-branched panicle 1—1·20 met. tall.

Peduncle basally flattened and 15 mm. broad, terete upwards, about 10-branched from the middle upwards, the bracts subtending lowest branches thin white papery brittle, 40 mm. long, 30 mm. broad, many-nerved.

Racemes rather densely flowered, cylindric-conical, up to 15—20 cm. long, erect or suberect, the buds denser and hidden by thick fleshy densely imbricate bracts, the open flowers laxer and nutant.

Bracts broadly ovate-cuspidate, somewhat fleshy in the middle and thinner at the edges, about 11 mm. long, 10 mm. broad, 7—9-nerved.

Pedicels 13 mm. long (up to 20 mm. in the fruit).

Perianth pale scarlet, minutely pubescent, cylindric-trigonous, 32 mm. long, cylindric and 7 mm. diam. across the ovary, slightly narrowed on underside above the ovary, thence trigonous and slightly enlarging to an open mouth; *outer segments* free for 12 mm., thinner and paler at the

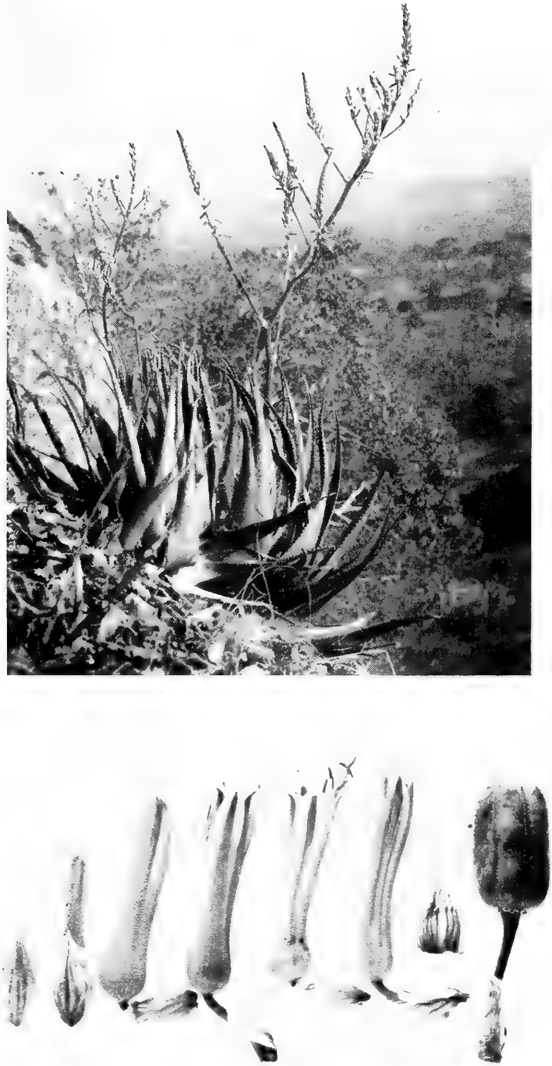

PLATE XX. *Aloe venusta* Reynolds.
Plant in natural habitat 71 miles south of Mpanda, Western Province, Tanganyika Territory. Height 1·20 met. Flowers 1/1 from bud to fruit stage.

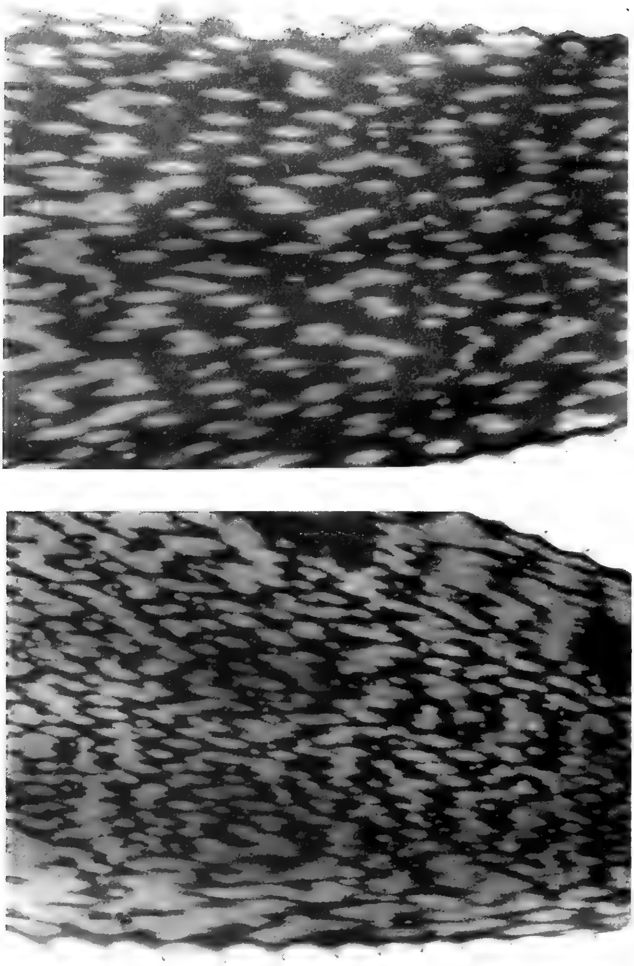

PLATE XXI. *A. venusta* Reynolds.
Upper: Portion of leaf upper surface 1/1.
Lower: Portion of leaf lower surface 1/1.

margins, the apices subacute and slightly spreading; *inner segments* broader than the outer, with broad pale marginal border and with three crowded nerves forming a slight keel, the apices more obtuse and more spreading than the outer.

Filaments pale lemon, the 3 inner narrower and lengthening before the 3 outer with their *anthers* in turn exserted 2—3 mm.

Stigma at length exserted 3—4 mm.

Ovary green, 6 mm. long, 3 mm. diam.

Capsule 20 mm. long, 12 mm. diam. at the middle.

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Dr. R. A. Dyer, Chief, Division of Botany, Pretoria, for the facilities of the National Herbarium Pretoria, and for many photographs.

Dr. N. R. Smuts for considerable assistance during our 9,900 miles of travelling together throughout Nyasaland and Tanganyika Territory.

SOUTH AFRICAN IRIDACEAE. A REVISION OF HEXAGLOTTIS

By G. J. Lewis

(*Compton Herbarium, Kirstenbosch*)

(With Plate XXII)

It seems remarkable that so small a genus as *Hexaglottis* should have been subject to much confusion, yet the three species named, described and figured in Europe and England during the eighteenth and early nineteenth centuries were so completely misunderstood by various botanists that a certain amount of confusion has persisted to this day. The three species involved occur on the Cape Peninsula and in my revision of the genus for Adamson and Salter's *Flora of the Cape Peninsula*, published in 1950, I separated them under their correct names but failed to mention one important detail, namely the presence of a perianth tube in *H. virgata*. In 1954 I referred to this omission in a paper, "Some Aspects of the Morphology, Phylogeny and Taxonomy of the South African Iridaceae" (Ann. S. A. Mus. xl, p. 93), and stated that a perianth tube in one of the species necessitated some amendment to the generic description.

The fourth species, *H. nana*, was not known until it was described by Dr. L. Bolus in 1932. As it is confined to the Clanwilliam Division and southern borders of the Van Rhynsdorp Division, it was not mentioned in the Peninsula Flora, and being quite distinct from the others it did not enter into the confusion which surrounded them. The following short account of the first three species described will give some idea of how the misunderstanding arose and of the need for a revision of the genus.

In 1776 Jacquin described and figured the first species, from plants cultivated in Europe, and named it *Ixia longifolia*. Five years later Linné f. described the second species, from plants collected at the Cape by Thunberg, which he named *Moraea flexuosa*, giving as a synonym *Ixia longifolia* Jacq. Since then most botanists have regarded the two species as being conspecific, some adopting the Linnaean specific epithet and others that of Jacquin.

Jacquin described the third species in 1789, again from plants cultivated in Europe, and gave a very good illustration of it in the second volume of his *Icones Plantarum Rariorum.* He commented on the fact that Linné had transferred his *Ixia longifolia* to *Moraea* with a different specific name, and although he expressed some doubt about the correctness of the procedure, since he maintained that according to the Linnaean System the presence of a perianth tube precluded its inclusion in the genus *Moraea*, he followed Linné f. in placing this species in *Moraea* and named it *Moraea virgata.*

The perianth tube of *M. virgata* was described by Jacquin as "infundibuliform", and it is evident both from this and his illustration of the flower that he took the very small cup formed by the suberect unguiculate portion of the lobes to be a continuation of the tube. The claws of the lobes in all species of *Hexaglottis* are connate for about 0·5 mm. at the base and free but more or less contiguous above, *H. virgata* being the only one which has a cylindrical tube 5—6 mm. long below the claws. It would appear, however, that Jacquin's reason for placing the first species he described in the genus *Ixia* and not *Moraea* is because he assumed that the very short erect cup in this species was a perianth tube. Lamarck, writing about *Moraea flexuosa* in his *Encyclopédie Methodique* in 1897 (Vol. iv, p. 277), appealed to botanists who had an opportunity of observing living plants to examine them with special attention to decide whether or not the flowers had a tube, since there had been some difference of opinion among botanists about this point on which it depended whether the plant should be placed as an *Ixia* or a *Moraea.*

Willdenow, Vahl and Roemer and Schultes all placed *Hexaglottis virgata* in the genus *Ixia*, yet for some reason the fact that this species has a perianth tube was overlooked by all later botanists. In 1869 an excellent illustration of this species was published in Saunders' *Refugium Botanicum* (Vol. 1, t. 24) as *Homeria flexuosa*, with a description by Baker, but although the perianth tube is shown above the ovary in one of the much enlarged figures (a copy of most of the figures from Saunders' plate is given in Fig. 3 of this paper), it was not mentioned by Baker in the description there, nor in his revision of *Hexaglottis* in the *Flora Capensis* in 1896 (Vol. vi, p. 31) where he did not cite the Saunders Ref. Bot. plate nor the name *Homeria flexuosa*, evidently having forgotten about it, and in the generic description described the perianth as "cut down to the ovary".

Ventenat established the genus *Hexaglottis* in 1808, with one species, *H. longifolia* (Jacq.) Vent. In 1830 Sweet placed two species in the genus, *H. flexuosa*, for which he gave us a synonym *Hexaglottis longifolia*

Vent., and *H. virgata*. Klatt, in 1866, united the three species of *Hexaglottis* with *Homeria spicata* Sweet, under that name. In the *Flora Capensis* Baker gave two species, *H. longifolia* and *H. virgata*, but it was

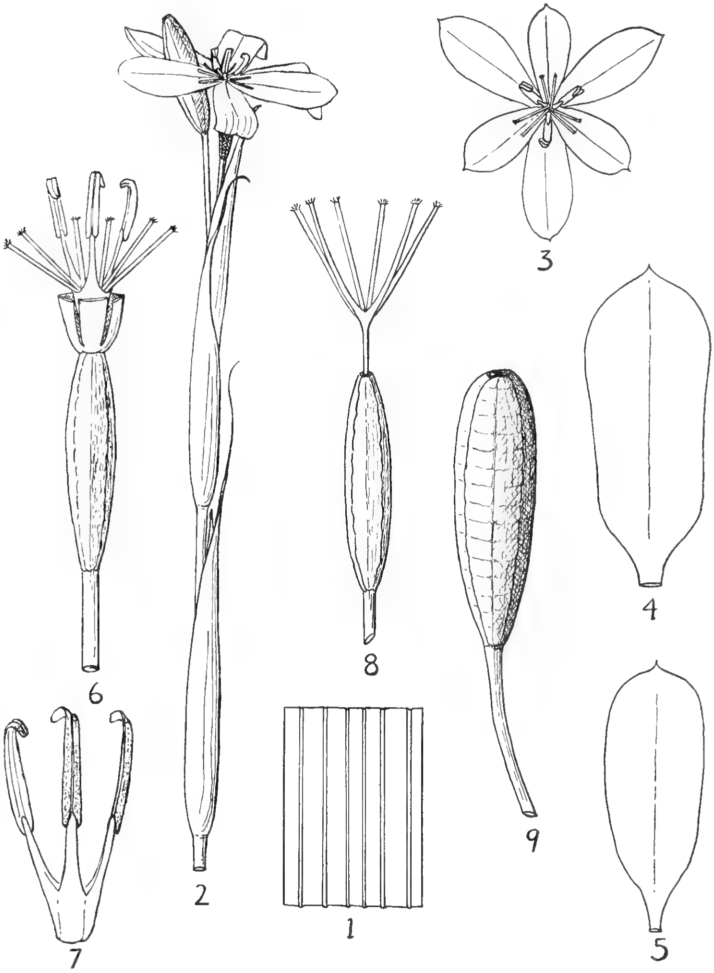

FIG. 1.—*H. longifolia*. 1. Portion of leaf, lower surface, × $1\frac{1}{2}$. 2. Top of inflorescence showing the terminal and penultimate cymes. 3. Flower. 4. Outer perianth lobe × 2. 5. Inner perianth lobe × 2. 6. Side view of flower with blades of perianth lobes removed, × 3. 7. Androecium × 4. 8. Gynaecium × 3. 9. Capsule × 2. *Del.* G. J. Lewis.

pointed out by N. E. Brown in 1928 that the descriptions and specimens quoted by Baker apply to neither of those species (Journ. Linn. Soc. xlviii, p. 52—footnote). Levyns, in the *Guide to the Flora of the Cape Peninsula* (1929) gave only one species for this area, *H. longifolia*, and Phillips, in the second edition of the *Genera of South African Plants* (1951) gave the number of species as 3, and "perianth tube 0".

The number of species given here is four, with two varieties in two of them. It is very probable that a specimen in the Bolus Herbarium from Garcias Pass in the Riversdale Division (No. 11387, collected by Bolus) represents a new species but it is necessary to see living plants to draw up a description and come to any decision. On the label the flowers are described as "white and purple", and as far as can be seen in the dried state the perianth lobes are considerably wider than in any known species. The flowers of three of the known species are yellow, sometimes brownish or greenish on the outer surface, and in *H. nana* they are either pale yellow or pale salmon pink. They are delicate, fugacious, and open only in the afternoon, fading towards evening, and emerge successively from the spathes which are two to five-flowered. When not in flower the plants, with their slender reed-like stems and trailing grass-like leaves, are very difficult to discern among the surrounding grasses and other vegetation, so that collecting material of this genus is by no means easy.

The genus is endemic and as far as is known occurs only in the winter rainfall areas of the Cape of Good Hope, from Namaqualand to the Cape and eastwards as far as the Port Elizabeth Division.

A sheet of *H. virgata* in the National Herbarium, Pretoria (No. 7813, from Rawsonville, Worcester Division) bears a label of the Division of Veterinary Education and Research, Onderstepoort, marked "Suspected Poisonous", but apart from this little if any investigation appears to have been made into the toxic potential of the genus. Watt and Breyer-Brandwijk did not mention *Hexaglottis* in the *Medicinal and Poisonous Plants of Southern Africa* but of its two closely allied genera, *Moraea* and *Homeria*, they stated that all species should be regarded as toxic until the contrary is proved, and I am of the opinion that this should apply to *Hexaglottis* as well.

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Bolus Herbarium, University of Cape Town .. .. BOL

South African Museum Herbarium, National Botanic Gardens of South Africa .. .. SAM

Compton Herbarium, National Botanic Gardens of South Africa	NBG
Conservatoire et Jardin Botanique, Geneva	G
Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie, Paris	P
Royal Botanic Gardens, Kew	K
National Herbarium, Pretoria	PRE
Botaniska Museet, Uppsala	UPS

To the Directors and Curators of these institutions thanks are due for facilities provided for examination of the specimens. In particular I have to thank the Directors and Curators of the Bolus Herbarium, the Royal Botanic Gardens, Kew, and the National Herbarium, Pretoria, for the loan of their material.

To Dr. C. G. Alm, Assistant Botanist (retired) of the Institute of Systematic Botany of the University of Uppsala, I wish to express my gratitude for photographs of four of Thunberg's sheets, one of which is reproduced here with his kind permission.

Hexaglottis

Vent. Decas Gen. Nov. 6 (1808); Benth. & Hook. f. Gen. Pl. 3: 692 (1883); Baker, Journ. Linn. Soc. 16: 99 (1877), Handbk. Irid. 75 (1892) and Fl. Cap. 6: 31 (1896); Dur. & Schinz Consp. Fl. Afr. 5: 159 (1895); Levyns Guide to Fl. Cap. Pen. 77 (1929); Diels in Engl. & Prantl Pflanzenfamilien ed. 2, 15: 496 (1930); Lewis in Adamson & Salter Fl. Cap. Pen. 225 (1950); Phillips Gen. S. Afr. Fl. Pl. ed. 2, 214 (1951).

Plantia Herb. in Edwards's Bot. Reg. 30: Misc. 89 (1844).

Name from the Greek *ex*, six, and *glottis*, a tongue, alluding to the six style branches.

The common name applied to *H. longifolia*, *H. flexuosa* and *H. virgata* is *Swartuintjie*.

Corm small, globose; tunics dark brown or blackish, coarse, lamellate, laciniate at the base, spinescent at the apex. *Stem* short or long, usually branched, the branches in one species very short. *Leaves* cauline, the lower 1—5 long, linear or linear-lanceolate, reflexed and patent, usually shortly amplexicaul at the base and above either flat, conduplicate or involute, sometimes appearing terete, prominently nerved or striate on the lower surface; upper 1—4 leaves short and spathe-like, acuminate the lower half usually amplexicaul. *Inflorescence* in one species fasciculate with terminal cymes on very short branches, in the others with many sessile lateral cymes on the axis and branches; cymes 2—5-flowered.

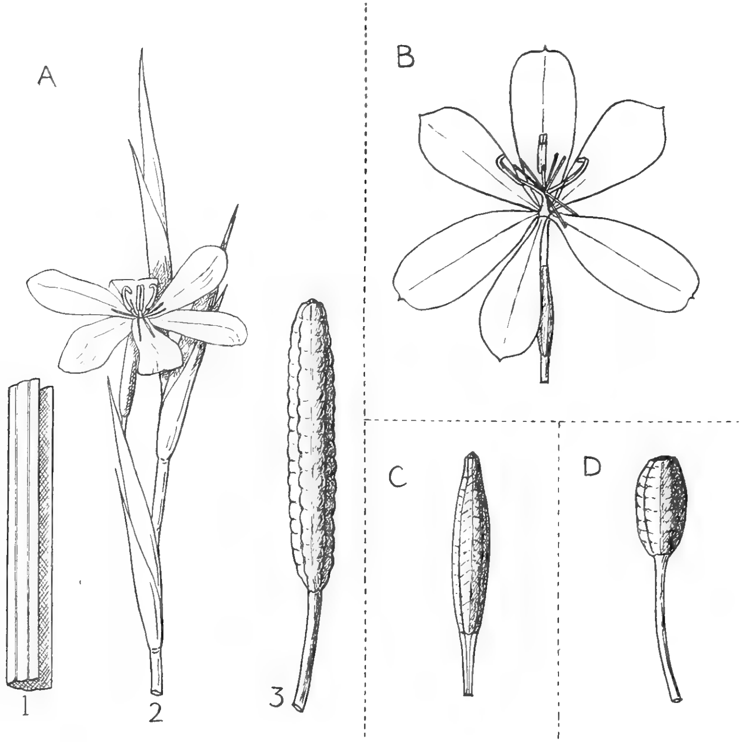

FIG. 2.—A. *H. flexuosa*. 1. Portion of leaf × 2. 2. Part of inflorescence. 3. Capsule, with part of pedicel, × 2. B. *H. virgata* var. *lata*. Flower laid out flat to show claws of perianth lobes and lower connate part of stamens. C. *H. virgata*. Capsule and pedicel × 2. D. *H. nana*. Capsule, with part of pedicel, × 2. Del. G. J. Lewis.

Spathes herbaceous, sometimes more or less dry and pallid at flowering time, the outer like the upper leaves, the inner similar, as long as the outer or slightly shorter or longer. *Flowers* pedicellate, fugacious and twisting up spirally in fading, usually yellow; *lobes* subequal, very shortly unguiculate with erect claws and oblong or obovate-oblong patent blades, one species with a short tube, the others with the claws connate at the extreme base. *Stamens* opposite the style branches; filaments as long as anthers or slightly shorter, the lower third connate in a tube; anthers linear-lanceolate, at first erect, later becoming circinate. *Ovary* cylindric or clavate-cylindric, in one species enclosed within the spathes, in others

PLATE XXII.
The type sheet of *Hexaglottis flexuosa*, in Thunberg's Herbarium, Uppsala.
By courtesy of the Botanical Museum of the University of Uppsala.

more or less exserted; *style* short, the branches longer and forked into filiform segments minutely ciliate at the apex. *Capsule* cylindric, oblong or clavate-oblong, in one species enclosed in the spathes, in others exserted; *seeds* numerous, small, dark reddish brown, turgid and angular.

The type species is *H. longifolia* (Jacq.) Vent.

KEY TO THE SPECIES.

1. Inflorescence usually branched, with many sessile lateral cymes on the axis and branches.
    2. Flower with a perianth tube; ovary and capsule always enclosed within the spathes .. .. (3) *virgata*
    2. Flower without a perianth tube; ovary and capsule partly to well exserted from the spathes.
        3. Stem usually 60 cm. to 1 m. or more high, if less then simple; cymes fairly widely spaced, rarely slightly imbricated; inner spathes usually enclosed within the outer except in the terminal cyme; capsule oblong or clavate-oblong .. .. (1) *longifolia*
        3. Stem usually less than 60 cm. high, branched and often flexuose; cymes nearly always closely spaced and more or less imbricate; inner spathes slightly to well exserted from the outer in lateral and terminal cymes; capsule cylindric, sulcate .. .. (2) *flexuosa*

1. Inflorescence fasciculate with 2 to several very short branches each with a single terminal cyme .. .. (4) *nana*

1. **H. longifolia** (Jacq.) Vent. Dec. Gen. Nov. 6 (1808); Salisb., Trans. Hort. Soc. 1: 313 (1812); Baker, Journ. Linn. Soc. 16: 100 (1877), Handbk. Irid. 76 (1892) and Fl. Cap. 6: 32 (1896), pro parte; Dur. & Schinz Consp. Fl. Afr. 5: 159 (1895), pro parte; Lewis in Adamson & Salter Fl. Cap. Pen. 225 (1950). *Ixia longifolia* Jacq. Hort. Vind. 3: 47 & t. 90 (1776). *Moraea longifolia* Pers. Syn. 1: 49 (1805), pro parte. *Homeria spicata* Klatt, Linnaea 34: 626 (1866), pro parte.

Corm 1·5—2 cm. diam.; tunics brown or greyish. *Stem* 60 cm. to 2 m. high, 3—6 mm. diam. at the base, nearly straight and erect or somewhat cernuous towards the apex in tall plants, flexible, simple or with 1—3 fairly short erect flexible branches. *Leaves* several, the lower 3—5 linear-lanceolate, amplexicaul for 1·5—5 cm. at the base, flat above, 30 cm. to 1·5 m. long, 0·7—1·5 cm. (occasionally to 2 cm.) wide near the base, fairly prominently 5—8-veined on the lower surface; upper cauline leaves 5—9 cm. long, the lower half amplexicaul, the upper appressed to the stem, acuminate, with along sphacelate setaceous cusp. *Inflorescence* of several sessile lateral 4- or 5-flowered cymes, usually fairly widely spaced on the stem and branches, occasionally somewhat closer with the setaceous tip of the spathe reaching shortly above the base of the next spathe above. *Spathes* 5—9 cm. long, the inner as long as the outer or slightly shorter and often concealed in the lateral cymes but slightly longer and

exserted in the terminal. *Flowers* scentless or with a faint unpleasant scent, yellow with a greenish medial line on the outer surface of the lobes; *lobes* very shortly unguiculate, the claws connate for about 0·5 mm., the blades oblong, obtuse or subacute, usually minutely apiculate, the outer 2—2·7 cm. long, 0·8—1·1 cm. wide, the inner 1·6—2·3 cm. long, 6—9 mm. wide. *Filaments* 5—6 mm. long, connate for 2—2·5 mm.; *anthers* 5—6 mm. long. *Pedicel* 4—4·8 cm. long. *Ovary* exserted from spathes, clavate-cylindrical, 1—1·2 cm. long; *style* 2—2·5 mm. long; style arms 5—6 mm. long. *Capsule* well exserted from spathes, oblong or clavate-oblong, 1·6—2·3 cm. long, 6—8 mm. diam.

Moist or shady places near streams on the Cape Peninsula from Orange Kloof to Newlands.

Type. Jacquin Hort. Vind. Vol. 3, t. 90.

Flowering period. October—November.

CAPE. Orange Kloof, by swamp, *Dod* 3479 (K, PRE); Kirstenbosch, in damp ground near stream, *Lewis* 673 (SAM, PRE); Kirstenbosch, near Pearson House, *Barker* 1965 (NBG); near Liesbeek River below Fernwood, *Salter* 8775 (SAM), 8973 (NBG), 8999 (BOL).

Without locality:—*Thunberg* (*Moraea flexuosa* sheet c in Herb. Thunb., specimen on left. UPS).

Var. **angustifolia** Lewis var. nov.

A var. *longifolia* foliis angustioribus, firmioribus et plerumque conduplicatis, spathis brevioribus et capsulis minoribus, distinguitur.

Folia linearia 3, circa 1 m. longa, basin versus 4—5 mm. lata, firma, prominenter nervata, plus minusve conduplicata. *Spathae* 2·5—5 cm. longae, aequales vel interior quam exterior leviter brevior vel longior. *Capsula* 0·8—1·5 cm. longa.

Differs from var. *longifolia* in having narrower, firmer and usually conduplicate leaves, shorter spathes and smaller capsules.

Leaves 3 linear, about 1 m. long, 4—5 mm. wide near the base, firm, prominently veined, more or less conduplicate. *Spathes* 2·5—5 cm. long, equal or the inner slightly shorter or longer than the outer, either concealed or shortly or up to half exserted. *Capsule* 0·8—1·5 cm. long.

Type. *Pillans* 8436 in the Bolus Herbarium.

CLANWILLIAM. Clanwilliam, moist grassy places on river bank, *Galpin* (BOL. s.n., PRE No. 11483).

PAARL. Du Toits Kloof, *Pillans* 8436 (BOL).

H. longifolia has generally been confused with *H. flexuosa* but the plants are usually much taller and stouter, with a straight flexible flowering stem, wider leaves and differently shaped capsules. The flowers of the two species are similar in appearance but those of *H. longifolia* have

little or no scent and those of *H. flexuosa* a strong unpleasant scent. The habitat also is different, as far as is known *H. longifolia* occurring only in the vicinity of streams or marshy places, often in shade under trees. The flowers open between 2 and 2.30 p.m. and start to curl up at about 6 p.m.

2. **H. flexuosa** (L. f.) Sweet Hort. Brit. ed. 2, 498 (1830), excl. syn. *H. longifolia* Vent.; Lewis in Adamson & Salter Fl. Cap. Pen. 225 (1950). *Moraea flexuosa* L. f. Suppl. 100 (1781), excl. syn. *Ixia longifolia* Jacq.; Thunb. Diss. Moraea p. 10 (1784), Prodr. 11 (1794), Fl. Cap. 1: 272 (1811) and ed. Schult. 70 (1823); *Murray, Linn. Syst. Veg. ed. 14, 93 (1784); *Gmel. Syst. Veg. ed. 13, 117 (1791); *Willd. Sp. Pl. 1: 243 (1797); *Vahl Enum. 2: 156 (1806); *Roem. & Schult. Syst. 1: 453 (1817); *Ker in Curtis's Bot. Mag. 19, t. 695 (1803) and Gen. Irid. 33 (1827); (*all excl. syn. *Ixia longifolia* Jacq.); Eckl. Top. Verz. 15 (1827). *Sisyrinchium flexuosum* (L. f.) Spreng., Syst. Veg. 1: 167 (1825). *Homeria flexuosa* (L. f.) Sweet Hort. Brit. ed. 1, 395 (1827). *Moraea longifolia* Pers. Syn. 1: 49 (1805), pro parte. *Hexaglottis longifolia* Baker, Journ. Linn. Soc. 16: 100 (1877), Handbk. Irid. 76 (1892) and Fl. Cap. 6: 32 (1896), pro parte; Dur. & Schinz Consp. Fl. Afr. 5: 159 (1895), pro parte. *Homeria spicata* Klatt, Linnaea 34: 626 (1866), pro parte.

Corm 1·5—2·5 cm. diam.; tunics dark brown or blackish, occasionally with a neck 2—3 cm. long. *Stem* 20—70 cm. high, usually 30—50 cm., 2—3 mm. diam. at the base, firm, usually flexuose, with 1—6 suberect more or less flexuose branches. *Leaves* few, the 1—3 lower linear, 75—90 cm. long, 3—6 mm. wide, amplexicaul for 1—2·5 cm. at the base and above flat, conduplicate or involute, the lower surface striate, sometimes minutely papillose-ciliate near the base; upper leaves 4—8 cm. long, acuminate, often with a long setaceous cusp. *Inflorescence* of many sessile lateral 4—5-flowered cymes on the axis and branches, nearly always fairly closely spaced and more or less imbricate. *Spathes* 2·5—5 cm. long, the inner usually longer than the outer and slightly to well exserted. *Flowers* with a strong, unpleasant scent, golden-yellow, sometimes with 2 or 3 minute greenish-brown dots at the base of the blade, sometimes only on the outer lobes, the outer surface with a green medial line and one side of the outer lobes sometimes reddish-brown; *lobes* with claws 1·5—2 mm. long, connate for about 0·5 mm., the blade of the outer oblong, obtuse, 1·8—2·4 cm. long, 0·7—1 cm. wide, and the inner obovate-oblong, obtuse, 1·6—2·2 cm. long, 0·7—1 cm. wide near the apex. *Filaments* 5—6 mm. long, connate for about 1·5 mm.; *anthers* 5—7 mm. long. *Pedicel* 3—3·5 cm. long. *Ovary* cylindrical, 1—1·2 cm. long, exserted or half exserted from the spathes; *style* 1·5—2 mm. long,

the branches 6—7 mm. long. *Capsule* cylindrical, sulcate, 1·5—2 cm. long, 2·5—3 mm. diam., exserted from spathes.

Usually grows in dry sunny places in hard gravel soil on flats, hills and lower slopes of mountains from Namaqualand to the Cape and from there eastwards to the George Division.

LECTOTYPE. Thunberg, *Moraea flexuosa* sheet b in Herb. Thunberg, Botanical Museum, Uppsala.

Flowering period. September—December.

NAMAQUALAND. Near Springbok, *Lewis* 743 (SAM); Klip Vlei, between Kamieskroon and Garies, *Thorne* (SAM No. 49973); between Brakdam and Rietkloof, *Pearson* 5664, partly (K).

VAN RHYNSDORP. Sandkraal, *Barker* 5665 (NBG); *Acocks* 14826 (PRE).

CLANWILLIAM. Near Clanwilliam, in rock crevices on hillside, *Galpin* (BOL); Clanwilliam, *Galpin* 376 (SAM).

PIKETBERG. N.E. margins of Verloren Vlei, in damp soil, *Pillans* 7803 (BOL); De Hoek, *Barker* 2558 (NBG); Porterville, *Loubser* 466 (NBG).

TULBAGH. Near the Berg River, *Thunberg* (UPS); near the Waterfall, *Ecklon & Zeyher* 29 (G, PRE); near Tulbagh, *Leighton* 1317 (BOL); Wolseley, *Barker* 2072 (NBG).

WORCESTER. Du Toits Kloof, *Stokoe* (SAM No. 60126).

PAARL. Berg River, near Paarl, *Drege* (K, P); *Barker* 8797 (NBG).

STELLENBOSCH. Stellenbosch Flats, *Garside* 66 (K).

MALMESBURY. Near Moorreesburg, *Bolus* (BOL); Mamre hills, *Compton* 9828 (NBG).

BELLVILLE. Sixteen miles N. of Cape Town on Malmesbury road, *Wasserfall* 768 (NBG).

CAPE. Between Cape Town and Table Mt., *Burchell* 34 (K); Table Mt., *Ecklon* 536 (G, K), 9 b (K); Bakoven, *Lewis* 971 (SAM); above Cannonball Bay, *Barker* 3240 (NBG); Flats near Rondebosch, *Burchell* 202 (K); Edinburgh Estate, Claremont, *Salter* 8788 (SAM); near Bishopscourt, *Salter* 9002 (BOL); Kirstenbosch, *Lewis* 672 (SAM); *Barker* 2609 (NBG); Rosebank, *Bolus* 3801 (BOL); behind Groot Schuur, *Dod* 360 (BOL, K); Royal Observatory grounds, *Davis* (SAM No. 61052); Noordhoek, *Barker* 2728 (BOL, NBG); Slangkop (Kommetjie), *Verreaux* (G).

CALEDON. Near Nieuwekloof, *Drege* 1533 (P); Rivierzondereinde, Appelskraal, *Ecklon & Zeyher* 31 (G); River Sonder End Mts., *Stokoe* (SAM No. 58335); between Dwarsberg and Somerset Sneeuwkop, Hottentots Holland Mts., *Stokoe* (SAM No. 58723); 8 miles from Stanford on road to Elim, *Gillett* 4506 (BOL); Genadendal, *Prior* (K).

BREDASDORP. Near Napier, *Leipoldt* 3551 (BOL).

SWELLENDAM. Storms Vlei Kloof, *Leipoldt* 3548, 3549—partly (BOL).

GEORGE. Great Brak River, *Young* (*Bolus* 5541, BOL); between George and Great Brak River, *Burchell* 6151 (K); near George, *Burchell* 6107 (K).

Without locality:—*Ecklon & Zeyher* 30 (G); *Zeyher* 1643 (K); *Mudd* (K); *Zeyher* 1644, partly (K); *Forster* (K).

Pillans 7803, from damp soil near Verloren Vlei, is considerably taller than usual, with 4 or 5 linear leaves, but this is probably due to the habitat.

The species is extremely variable with regard to the size of the plants and the degree of bend in the stem and branches, the width of the leaves and length of the spathes, and it is seldom found that specimens from two different localities are exactly alike. The plants usually favour open sunny places but may sometimes occur both in sun and partial shade in the same area, in which case it has been observed that the plants in semi-shade are taller, less branched and much less flexuose than those a few yards away in the open. It has also been noticed that plants in semi-shade, or kept indoors, have their flowers more exserted than usual. The plant figured by Ker in the *Botanical Magazine*, t. 695, represents a typical shade form of this species.

There are four sheets in Thunberg's Herbarium named by him *Moraea flexuosa*, but one sheet contains part of an inflorescence of *Hexaglottis longifolia* and specimens of genera other than *Hexaglottis* are mounted on some of them (for details about these specimens see the article by N. E. Brown on the South African Iridaceae in Thunberg's Herbarium, Journ. Linn. Soc. xlviii, p. 52 (1928)). The second sheet, b, has been selected as the lectotype of *Hexaglottis flexuosa* as it contains three specimens, all of this species, one of them complete with corm. A photograph of this sheet is reproduced here, Plate XXII.

N. E. Brown remarked that none of the specimens in Kew Herbarium matched Thunberg's type, and was of the opinion that some of them represented unnamed species, but after examining a number of living plants and a wide range of material from various herbaria I cannot agree with this view and have not been able to find any uniform characters which would enable me to separate varieties.

The flowers in this species open slightly later than in *H. longifolia*, from 3 to 3.30 p.m., and remain open until dusk, between 7 and 8 p.m.

3. **H. virgata** (Jacq.) Sweet Hort. Brit. ed 2, 498 (1830); Baker, Journ. Linn. Soc. 16: 100 (1877), Handbk. Irid. 76 (1892) and Fl. Cap. 6: 32 (1896), name and synonomy only; Dur. & Schinz Consp. Fl. Afr. 5:

159 (1895); Lewis in Adamson & Salter Fl. Cap. Pen. 225 (1950). *Moraea virgata* Jacq. Ic. t. 228 (1786–93), Coll. 3: 194 (1789); Ker, Bot. Mag. sub t. 1103 (1808) and Gen. Irid. 33 (1827); Spreng. Syst. 1: 164 (1825); Lam. Ill. 1: 115 (1791), Encyc. 4: 277 (1797); Pers. Syn. 1: 49 (1805). *Ixia virgata* Willd. Sp. Pl. 1: 202 (1798); Vahl Enum. 2: 59 (1806); Roem. & Schult. Syst. 1: 384 (1817). *Homeria virgata* Sweet Hort Brit. ed 1, 395 (1827). *Homeria spicata* Klatt, Linnaea 34: 626 (1866), pro parte. *Homeria flexuosa* Baker in Saund. Ref. Bot. 1, t. 24 (1869), non Sweet (1827). *Plantia flava* Herb. in Edwards's Bot. Reg. 30: Misc. p. 89 (1844).

Corm 1·5—3 cm. diam.; tunics very dark brown or blackish. *Stem* stiff and virgate, rarely somewhat flexuose, 20—85 cm. high (usually 30—50 cm.), 2—4 mm. diam. at the base, with 2—6 fairly long suberect virgate branches, sometimes shorter and simple or with 1—2 branches. *Leaves* occasionally 1 but usually 2—3 linear, 0·6—1·4 m. long, 3—5 mm. wide near the base, amplexicaul for 1—2 cm. at the base and above firmly involute and often appearing terete or sometimes flat or partly flat, striate beneath, more or less brown and dry at time of flowering; upper leaves 4—10 cm. long, appressed to the stem, long aristate. *Inflorescence* spike-like in appearance with numerous closely appressed sessile imbricate 2- or 3-flowered cymes on the axis and branches. *Spathes* usually dry and pallid at time of flowering, 2·5—4 cm. long, acute or acuminate, the outer sometimes aristate, equal in length or the inner slightly shorter or longer than the outer. *Flowers* yellow with a green medial vein on the lobes, scentless or with a faint unpleasant scent. *Perianth tube* 5—6 mm. long, cylindrical, not or scarcely expanded at the throat, sometimes included and sometimes partly exserted from the spathes; *lobes* very shortly unguiculate, oblong, obtuse, 5—7 mm. wide, the outer 1·6—2 cm. long, the inner 1·3—1·9 cm. long. *Filaments* 5 mm. long, connate for 1·5—2 mm.; anthers 6—7 mm. long. *Pedicel* 5 mm. long. *Ovary* cylindrical, 1·2 cm. long, included in spathes; *style* 1·5—2 mm. long, the branches 5 mm. long. *Capsule* included in spathes, cylindrical, pallid, about 1·5 cm. long, 3 mm. diam.

Usually occurs in hard gravel, clay or limestone soils on hills and lower slopes of mountains from the Worcester, Ceres, Paarl and Stellenbosch Divisions to the Cape and eastwards to Port Elizabeth.

TYPE. Jacquin Ic. t. 228.

Flowering period. November—January.

CERES. Leeuwfontein, Cold Bokkeveld, *Pearson* 3508 (K).

WORCESTER. Bains Kloof, *Schlechter* 9106 (BOL, G, K, PRE); Karoo Garden, Worcester, *Compton* 17849 (NBG); *Lewis* 5304 (NBG); near Breede River, 8 miles W. of Worcester, *Lewis* 5309 (NBG); Rawsonville, *Le Roux* (PRE No. 7813).

FIG. 3.—*H. virgata.* 1. Portion of lower part of stem and base of leaf. 2. Upper part of inflorescence. 3. Outer perianth lobe, approx. $2\frac{1}{2}$ times nat. size. 4. Inner perianth lobe, approx. $2\frac{1}{2}$ times nat. size. 5. Stamens, style and style branches, approx. 3 times nat. size. 6. Flower with part of perianth lobes removed, approx. 3 times nat. size. Copied from Saunders' Ref. Bot. **1**, t. 24.

PAARL. Paarlberg, *Drege* (P).

STELLENBOSCH. Four miles from Faure on road to Stellenbosch, *Lewis* 2340 (SAM).

CAPE. Green Point, *MacGillivray* 479 (K); kloof between Lions Head and Table Mt., *Burchell* 252/1 (K); Signal Hill, *Marloth* 7234 (PRE); *Lewis* 665 (SAM); lower slopes of Table Mt., Mowbray, *Zinn* (SAM No. 54336); *O. Kuntze* (K); Royal Observatory grounds, *Davis* (SAM No. 61050); Kirstenbosch, N. of Window Stream, *Esterhuysen* 481 (NBG); near Bishopscourt, *Salter* 9001 (BOL); Wynberg Hill, *Salter* 8978 (NBG, SAM); Bergvliet, near Diep River, *Purcell* (SAM No. 16381); Westlake, lower mountain slopes, *Lewis* 1218 (SAM); Steenberg, *Compton* 16651 (NBG); Buffels Bay, *Salter* 328/14 (BOL).

SOMERSET WEST. Somerset West, *Parker* 4388 (BOL, K, NBG).

CALEDON. Elgin, *Lewis* 5317 (NBG); Onrust River, *Van Niekerk* 321 (BOL); Houw Hoek, *Penther* 572 (K).

BREDASDORP. The Poort, limestone hills, *Esterhuysen* 19580 (BOL); Napier, rhenoster hills, *Marloth* 10006 (PRE).

SWELLENDAM. Malagas, *Leipoldt* 3550 (BOL); Potteberg, *David* (NBG); Suurbrak, *Barker* 5029 (NBG); below Ten O'Clock Mt., in pasture, *Wurts* 486 (NBG); Storms Vlei Kloof, *Leipoldt* 3549, partly, (BOL).

HEIDELBERG. Grootvadersbosch, along paths in forest, *Willems* 88 (NBG).

RIVERSDALE. Limestone hills near Still Bay, *Esterhuysen* 19538 (BOL, PRE); Onverwacht, Albertinia, *Muir* 1207 (BOL).

MOSSEL BAY. Attaquas Kloof, *Barker* 7692 (NBG).

UNIONDALE. Joubertinia, *Esterhuysen* 6772 (BOL).

PORT ELIZABETH. Green Bushes, *Holland* 4051 (BOL).

Without locality:—*Zeyher* 1644, partly (K).

Salter 328/14, from Buffels Bay, is much smaller than usual, the plants 10—15 cm. high, with filiform leaves.

Var. **lata** Lewis var. nov.

A var. *virgata* segmentis perianthii latioribus et spatha interiore quam exteriore leviter longiore et partim exserta, distinguitur.

Perianthii tubus 5—7 mm. longus; segmenta exteriora oblonga, 2·2—2·5 cm. longa, 1 cm. lata; segmenta interiora obovato-oblonga, 2—2·2 cm. longa, apicem versus 0·9—1 cm. lata.

Differs from var. *virgata* in having much wider perianth lobes and the inner spathe slightly longer than the outer and partly exserted.

Perianth tube 5—7 mm. long; outer lobes oblong, 2·2—2·5 cm. long, 1 cm. wide; inner lobes obovate-oblong, 2—2·2 cm. long, 0·9—1 cm. wide near the apex.

Hills and mountain slopes in the Clanwilliam Division and Namaqualand.

TYPE. *Lewis* 2514 in the South African Museum Herbarium, National Botanic Gardens of South Africa.

Flowering period. September.

NAMAQUALAND. Stinkfontein, on hills, 2,900 ft., *Schlechter* 11486 (BOL).

CLANWILLIAM. Hard gravel soil near foot of mountains at Welbedacht, Bidouw River Valley, *Lewis* 2514 (BOL, PRE, SAM).

As it is not possible to dissect a flower of Schlechter's specimen in the Bolus Herbarium, it is not certain that it is this variety, but it can be seen that the flower has a perianth tube and the plant closely resembles the type, with the inner spathes slightly longer than the outer.

Even when not in flower this species can nearly always be distinguished from the two preceding by its straight rod-like branches which are seldom slightly flexuose. In flower and fruit it is readily distinguished by the perianth tube and the ovary and capsule which remain entirely concealed within the spathes. The character of the leaves was used by Baker in the *Flora Capensis* to separate *H. virgata* from *H. longifolia* (with which he united *H. flexuosa*) but little importance can be attached to these organs as in *H. virgata* they have been found to be partly flat and partly involute, appearing terete, on the same plant. In any case, Baker confused the three species and the descriptions and specimens quoted by him in the *Flora Capensis* for *H. longifolia* and *H. virgata* apply to neither of those species, as was pointed out by N. E. Brown (see introduction to this revision).

Baker placed *Plantia flava* Herb. as a synonym of *H. longifolia* but from Herbert's description it is evident that the plant described was *H. virgata*, and that the perianth tube was taken to be an extension of the ovary, such as occurs in the genus *Gynandriris*. This is not the case, however, as in *H. virgata* there is an articulation between the ovary and perianth tube and when dry the whole flower, with its tube, falls away.

4. **H. nana** L. Bol., Kew Bull. 1932, p. 326.

Corm 1—3 cm. diam., usually 1—1·5 cm.; tunics dark brown. *Plant* (including inflorescence) 10—30 cm. high, the stem below the inflorescence 5—25 cm. high, terete, usually firm, 1—2 mm. diam. *Leaves* 2—4, fasciculate immediately below the inflorescence, the lowest 15—45 cm. long, up to 8 mm. wide at the base, linear, flexuose, coriaceous, firmly involute or sometimes flat or partly flat and partly involute, striate, spinescent, the 1—3 successive leaves alike, 4—12 cm. long, up to 1·1 cm. wide at the base, firm, suberect or erect and spathe-like, callus-tipped, the

margins sometimes minutely papillate-ciliate. *Inflorescence* fasciculate, composed of 2 to several very short branches from 1 or 2 mm. to 3 cm. long, each with a terminal 2—3-flowered cyme. *Outer spathe* 2—6 cm. long, acute or acuminate, varying from shorter to longer than the inner; *inner spathe* 2—4 cm. long, obtuse or subtruncate, the apex slightly lacerate. *Flowers* yellow or pale salmon-pink; *lobes* with claws 1·5—3·5 mm. long, connate for about 0·5 mm. and oblong or obovate-oblong blades, the outer 1·7—2 cm. long, 0·8—1·1 cm. wide, the inner 1·6—1·8 cm. long, 6—8 mm. wide. *Filaments* 6—7 mm. long, connate for about 3 mm.; *anthers* 5 mm. long. *Pedicel* 1·5—3 cm. long. *Ovary* cylindrical, 6 mm. long, usually half exserted from spathes; *style* 2·5—3 mm. long, the branches 4—6 mm. long. *Capsule* oblong, 6—8 mm. long, 3·5—4 mm. diam., exserted from spathes.

Occurs in dry places on hills and lower slopes of mountains in the Clanwilliam Division and southern parts of the Van Rhynsdorp Division.

TYPE. *Weintroub*, BOL No. 19972, in the Bolus Herbarium.

Flowering period. September—October.

VAN RHYNSDORP. Sandkraal, *Acocks* 14827 (PRE).

CLANWILLIAM. Modderfontein, 3,500 ft., *Drege* 2611 (K, P); Nardouw Pass, *Stokoe* 8476 (BOL, SAM); *Lewis* 1875 (SAM); *Leipoldt* 3547 (BOL, PRE); *Barker* 4749 (NBG); Pakhuis Pass, *Barker* 256 (NBG); Olifants River Valley, 8 miles S. of Clanwilliam, *Gillett* 4075 (BOL, NBG, PRE); near Citrusdal, *Salter* 2727 (BOL); near Warm Baths, *L. Bolus* (BOL. No. 20321); between Clanwilliam and Berg Valley, *Lewis* 1876 (SAM); Berg Valley, *Compton* 20038 (NBG); Kransvleiberg, *Barker* 4756 (NBG); between Groot Rivier and Elands Kloof, *Leipoldt* 3011 (BOL, PRE).

The fasciculate inflorescence of *H. nana*, often somewhat umbellate in appearance with its abbreviated branches each with a solitary terminal cyme, serves to distinguish this species from the other three.

THE ORIGIN OF AFRICAN PROTEACEAE

By J. S. Beard

A recent paper by Levyns (4) in this Journal put forward evidence for a northern origin of the African Proteaceae. While unfortunately some of this evidence was based upon inaccurate data, it is possible at least partly to support the author upon other grounds.

A point is made that many of the tropical species of Protea show a very wide type of distribution and marked discontinuities within their range, whereas Cape species show a continuous type of distribution over a limited area. In fact, the discontinuities in the tropical species are more apparent than real. A false impression has arisen due partly to inadequate collecting in tropical Africa and partly to taxonomic confusion.

The three species cited by Levyns, *P. gaguedi*, *P. madiensis* and *P. angolensis* together with *P. hirta* are the "big four" among tropical Proteas and are in fact to be found practically everywhere that there are Brachystegia woodlands. They are in fact "liable to be found throughout their range wherever a suitable habitat occurs" as in the case of Levyns' Cape species. There are no marked discontinuities except in the one case, the occurrence of *P. angolensis* in western West Africa without (and this is apparently reliable) anything else nearer than Angola.

The synonymy and distribution of these species are as follows:—

P. gaguedi Gmel. = *P. abyssinica* Willd., *P. busseana* Engl., *P. chrysolepis* Engl. & Gilg, *P. leucoblepharis* (Welw. ex Hiern) Baker, *P. manikensis* de Wild, *P. ramosa* Hauman, *P. trigona* Phillips. Throughout Brachystegia belt at lower altitudes, on the east extending north to Eritrea and south to Zululand.

P. madiensis Oliv. = *P. bequaertii* de Wild. Central Brachystegia belt at higher altitudes, absent from S. Rhodesia, rare in Angola. Extending north into S. Sudan and across the Sudan region west to Nigeria.

P. angolensis Welw. is polymorphic: the aggregate species embraces *P. chionantha* Engl. & Gilg with vars., *P. bianoensis* de Wild., *P. homblei* de Wild., *P. trichanthera* Baker, *P. wangenheimii* Engl. Throughout the Brachystegia belt at middle elevations and in western West Africa.

P. hirta Klotzsch = *P. congensis* Engl., *P. eickii* Engl., *P. goetzeana* Engl., *P. kirkii* C. H. Wright, *P. melliodora* Engl. &

Gilg, *P. myrsinifolia* Engl., *P. swynnertonii* C. H. Wright, *P. uhehensis* Engl., *P. welwitschii* Engl.

Throughout the Brachystegia belt at middle to high elevations, extending north to Uganda and south to Transvaal and Natal.

The number of tropical species of Protea is thus much less than the 54 in the literature; there is also much reduction to synonymy among species other than those above. Confusion has been due to the high variability of the material. It is the writer's opinion that it is not possible to understand these plants adequately unless they are studied in the field.

Although Levyns' evidence for considering the tropical species of Protea as the older must be discounted, there is other evidence pointing to her conclusion. In general, there are two types of habitat characteristic of the tropical Proteas. One set of species occurs as undershrubs in Brachystegia woodland and they tend to be of wide range because the habitat is very extensive. A second group consists of components of an ericaceous mountain woodland or scrub, at higher elevations than the former group. As is usual in mountain floras the species tend to be localized rather than of wide distribution. Sometimes the ericaceous zone is intact, sometimes it has been destroyed or damaged by fire, in which case the Proteas, being fire resistant, may be left as survivors in mountain grassland. They may even be led to become more abundant and to form parklands by themselves, like *P. madiensis* on the Vipya highland in Nyasaland. There is no particular morphological distinction between the species of the two habitats. Tropical Proteas belong either to Phillips' sections *Lasiocephalae* and *Leiocephalae* or to the new section *Patentiflorae* Beard (1), which are poorly represented in the Cape flora, while none of the other sections of the genus occur outside the Cape fynbos except for one species of Ligulatae and two of Exsertae, which are found in the summer rainfall area of the Union. There is thus quite a strong morphological distinction between tropical and Cape Proteas.

It is considered that there are good grounds for the view that many of the tropical species, in particular those of the Patentiflorae, are less highly evolved than those of typical Cape sections of the genus and are thus more primitive. Before going into detail, some reference is necessary to other Proteaceous genera. Levyns shows that there are fourteen genera of the family in Africa, of which eleven are confined to the western Cape, one (Protea) occurs about as abundantly outside the Cape flora as in it, one (Leucospermum) has a single extra-Cape species reaching Rhodesia, and one (Faurea) is confined to tropical and sub-tropical Africa and

Madagascar. If we examine the inflorescences of these genera it must be concluded that that of Faurea is apparently the most primitive, consisting of a long spike along which the flowers are laxly arranged. Evolution in the family appears to have led to progressive compression of the spike with the flowers increasingly crowded, first into a short spike as in some species of Leucospermum, Paranomus, Mimetes, etc., then into dense heads with the receptacle at first elongated or conical, later flattened, later still (or as a separate evolutionary line) with bracts to enclose the flowers. Other evolutionary trends that we may distinguish are the introduction of dioecism as in Leucadendron and the transition from trees, as in Faurea, to shrubs of smaller and smaller stature ending as low woody plants with ephemeral shoots emitted from an underground rootstock.

Within the genus Protea itself we may distinguish many of these evolutionary trends. It is considered that the section Patentiflorae contains the most primitive species. Certain of them (*P. rubropilosa*, *P. comptonii*, *P. curvata*, *P. rupestris*) have a markedly conical receptacle in the flower head, they are small erect trees whose habit suggests Faurea rather than Protea, and their distribution suggests that they are ancient, relict species. Other Patentiflorae have only a convex receptacle, are small spreading trees and shrubs and have a wide distribution. All of them share the character which gives the name to the section and is itself considered primitive, namely *eversion* of the flower head. The bracts function only as bud scales and once the head has opened at anthesis it remains wide open until the seed is shed. The heads are large and showy and they open widely, at least to 180°, sometimes more. In *P. rupestris* (syn. *P. bella*) the bracts reflex completely and recall the behaviour of *Leucospermum reflexum*. Typical members of this group of Patentiflorae are *P. angolensis*, *P. madiensis* and *P. elliottii*.

The sections Lasiocephalae and Leiocephalae suggest some evolutionary advance, as the bracts have an additional protective function. After anthesis the heads close once more, the bracts coming together as in bud, and remain closed while the seeds are ripening. Eventually they open again and the seeds are blown away. There is also some reduction of head size and showiness. Many of them are shrubs or sub-shrubs. The Lasiocephalae have retained the primitive character of hairy flowers while the Leiocephalae largely discard it.

The tropical Proteas appear to show evidence of a slow, steady evolution extending over a very long period and together with the occurrence of primitive Faurea suggest that the Proteaceae have an ancient history in Central Africa. The Cape members of the family on the other hand seem to suggest rather a relatively recent exuberant out-

burst of speciation. Considering again the case of Protea, many of the Cape species are specialized mountain plants which must have developed close adaptations to harsh local environments, probably over quite a long period. The species of lower elevations, however, by their multiplicity, their exuberance, and the extraordinary developments of their floral parts which sometimes border on the fantastic and seem to be purely non-adaptive, suggest the filling of some floristic vacuum.

How could this have occurred? Good (3), in a recent paper in Nature, has outlined a probable course of floristic development in Australia associated with the likely movements of that continent since the disruption of Gondwanaland. A similar construction for the African continent may be informative.

It is pointed out by Good that the Australian flora contains three main elements: an "Afro-Australian" element, in which the Proteaceae are prominent, a "south circumpolar" rain-forest element and a "Melanesian" rain-forest element. Southern Africa contains an Afro-Australian element, lacks the south circumpolar rain-forest element, and has a tropical African rain-forest element which behaves in a similar manner to the Melanesian in Australia, extending south and westwards along the east coast and becoming progressively impoverished in species as it does so. Southern Africa also has an endemic desert flora which has no real counterpart in Australia.

Evidence from the movements of the ice sheets which deposited the Dwyka tillite (? U. carboniferous) indicate that Southern Africa then lay over the South Pole (or that the Pole then lay in S. Africa). During subsequent Permian and Triassic times progressively warmer conditions seem to have prevailed. According to Du Toit's (2) reconstruction of the movements of Africa since the disruption of Gondwanaland, the continent moved to the north until it came into contact with the land-mass of Europe, after which there was a retreat to the southward. The southern parts of Africa therefore first became progressively warmer and less under the influence of the belt of westerly winds, and the weather regime changed probably entirely to one of summer rain. Later, with the southerly movement of the continent, the southern coast became once more subject to the westerlies.

The flora of Southern Africa, if basically Afro-Australian at the close of the Mesozoic period and characteristic of a moist, warm-temperate climate such as is found to-day in latitudes 30°—40° S., would have had either to adapt itself to tropical and sub-tropical conditions or take refuge in the mountains. The original warm-temperate lowland flora (including the south circumpolar rain forest flora) would have been exterminated. Later as conditions grew again more temperate there was no

land to the southwards from which plants suited to the new conditions could immigrate, leading to a floristic vacuum, a condition, we may suppose, encouraging to the formation of new species.

It is apparent that the ancestors of the present Afro-Australian flora must have been established in the southern hemisphere while Africa and Australia were still in contact since although Africa could very well have received this flora from the north at a later date it is impossible to see how Australia could have done so. It is also a reasonable assumption that it was a warm-temperate flora. Among the Proteaceae, Faurea, the most primitive genus, inhabits tropical bush towards its upper altitudinal limits and its ancestors must have originated or adapted themselves there. The most primitive Proteas that we can trace occur along the ecotone between tropical bushveld and montane ericaceous bush or grassland. This zone lies closest to the environment of a more southerly warm-temperate flora. The adaptations of newer species may be supposed to have led them into the higher levels of tropical bush on the one hand and into the montane zone on the other.

When the southward movement of Africa provided a cool, moist lowland habitat along the southern and south-western coast the obvious source of plants to colonize it would be the upper mountain areas, already plentifully endowed with Proteaceae, Ericaceae and so on. In descending to lower altitudes to fill the vacuum it is logical that an exuberant outburst of speciation may have occurred. While the flora of the south-western Cape seems therefore to be basically of southern origin, it would be so at second hand, so to speak, being derived directly from a tropical montane flora that may have had its origin in Gondwanaland.

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CHROMOSOME NUMBERS IN ALOE

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Since H. A. C. Müller's observations on the chromosomes of *Aloë striata* Haw. in 1912, chromosome counts have been determined for a large number of species of Aloe, Gasteria and Haworthia. There are 14 somatic chromosomes in almost all the species that have been studied in the first two genera, but a rather large amount of polyploidy is found in Haworthia, most of which is in the Coarctatae and Tessellatae sections. In the diploid plants, the haploid complement consists of four long and three short chromosomes, although the small ones are considerably larger than the chromosomes of many other genera of the flowering plants.

The writer (Riley, 1958, 1959a) has recently recorded the chromosome number of Aloe plants which he collected at de Wildt in the Transvaal or at or in the neighbourhood of the Great Fish River in the Cape, or which were given to him by Mr. A. Berg of Pretoria, Mr. H. Hall of Kirstenbosch or Dr. E. A. Schelpe, Curator of the Bolus Herbarium. The purpose of that study was to obtain further information on the frequency of polyploidy in the genus. Another paper dealing with chromosome numbers in Gasteria is also being published (Riley, 1959b).

During the course of the study on Aloe, a careful examination of the literature was made to compare the writer's results with those recorded by other investigators. No general tabulation of the chromosome numbers in Aloe has been published since Müller's (1945) thorough study and unfortunately his excellent paper is not widely known since it was published as a doctoral dissertation of the University of Pretoria rather than in an international journal and because it is written in Afrikaans. The writer is greatly indebted to Professor J. D. J. Hofmeyr of the University of Pretoria for calling it to his attention and to Professor F. G. Schweicherdt for the gift of his last spare copy. Since the publication of Müller's paper, papers have appeared by Afify (1945), Mendes (1950) and Snoad (1951a, 1951b) which list a large number of additional counts. Because of the general obscurity of Müller's list and because of the more recent chromosome determinations of the writer and others, it seems desirable to compile an up-to-date list which would include all the observations that have been published up to this time. Such a list will clearly reveal the

frequency of polyploid or aneuploid chromosome numbers and will give some indication of the importance or lack of importance of differences in chromosome numbers in the evolution of the genus. While such a compilation should be of some value to all botanists interested in cytogenetic problems, it should be especially important for those of South Africa, where most of the species are found.

The list of chromosome numbers is to be found in Table 1 and includes the South African species and varieties arranged according to Reynolds's (1950) monograph, one plant of horticultural origin, a large number of putative hybrids, species found in countries other than the Union, species and varieties which are listed in neither Reynolds (1950) nor Jacobsen (1954) and which are probably of doubtful status, and 36 unidentified plants. This list includes all the chromosome counts that the writer was able to find in the literature. It probably lists all the important papers but may inadvertently omit some of the obscure ones. In the table are given the haploid or duploid number or both and the authorities for the various numbers reported.

Of the South African taxa as listed in Reynolds (1950), 80 species and nine varieties are diploid, one species is apparently a hexaploid and one species is reported as a diploid in one study and a hexaploid in another. This tabulation does not include plants regarded by Reynolds as synonyms. For example, *A. saponaria* Haw. was also listed as *A. latifolia* Haw. by Sato (1937, 1942) and *A. macracantha* by Johansen (1929) but has been counted only once. Also, the number of plants studied has been ignored and Riley's (1959a) 40 plants of *A. Davyana* are listed only once.

One horticultural form and 19 putative hybrids, including some published as species, such as *A. runcinata* Bgr. and *A. spuria* Bgr., are diploids. Of the plants growing outside the Union, 15 species and four varieties are diploid and only *A. ciliaris* f. *gigas* Res. is a polyploid. The 11 species not to be found in either Reynolds (1950) or Jacobsen (1954) are diploids. Thirty-one unidentified plants are diploids, one is a pentaploid and four are hexaploids.

Taking all the species, varieties, horticultural forms, hybrids and unidentified plants together, 95 per cent are diploids and only 5 per cent are polyploids. This percentage might be misleading, however, because of the unidentified plants. There is no evidence to indicate that each unidentified plant represents a different species and to include them might introduce a source of error especially, for example, if the four hexaploids all belong to the same species. If the unidentified plants are omitted, about 98 per cent of the identified types are diploids. Of the South African species, not including their varieties, only two out of 82, or about 2·5 per cent have polyploid individuals. Furthermore, it is of interest

to consider the species that have been found with polyploid forms. They are *A. ciliaris* Haw., *A. ciliaris* f. *gigas* Res., *A. Tidmarshii* (Schonl.) Müller and *A. tenuifolia* Lam. The last is not found in either Reynolds nor Jacobsen and perhaps can be omitted. *A. Tidmarshii* has been considered to be a variety of *A. ciliaris*. Therefore, if *A. tenuifolia* is disregarded and if *A. Tidmarshii* is considered as merely a variety, then *A. ciliaris* becomes the only species on Aloe that possesses individuals with more than 14 chromosomes. At any rate, it can safely be stated that Aloe is a genus with a very low incidence of polyploidy and one in which differences in chromosome number have had little, if any, effect on evolution.

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TABLE 1.

The species of Aloe for which the chromosome numbers have been reported.

The species are arranged according to Reynolds (1950).

Species or variety	n no.	$2n$ no.	Authorities
SOUTH AFRICAN SPECIES LISTED BY REYNOLDS (1950)			
Sec. 2 Graminialoe Reynolds:			
A. Saundersiae (Rey.) Reynolds as *Leptaloe Saundersiae* Rey.	7	14	Müller, 1945
A. albida (Stapf.) Reynolds as *Leptaloe albida* Stapf.	7	14	Müller, 1945
Sec. 3 Leptaloe Berger			
A. kniphofioides Baker as *A. Marshalli* Wood et Evans	7	14	Müller, 1945
A. chortolirioides Berger	7	14	Müller, 1945
A. nubigena Groenewald	7	14	Müller, 1945
A. verecunda Pole Evans	7	14	Müller, 1945
A. Vossii Reynolds	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. integra Reynolds	7	14	Müller, 1945
A. microcantha Haw.	7	14	Müller, 1941
A. Cooperi Baker	7		Kondo & Megata, 1943
	7	14	Müller, 1945
		14	Resende, 1937a; Riley, 1959a
A. Boylei Baker	7	14	Müller, 1945

Species or variety	*n* no.	2*n* no.	Authorities
Sec. 4 Eualoe Berger:			
A. longistyla Baker		14	Resende, 1937a
A. aristata Haw.		14	Resende, 1937a; Sato, 1937, 1942; Kondo & Megata, 1943; Riley, 1959a
as *A. aristata* Schult.		14	Snoad, 1951a
as *A. aristata* var. *leiophylla* Baker		14	Resende, 1937a
A. humilis (L.) Miller		14	Sato, 1937, 1942
as *A. humilis* Haw.		14	Resende, 1937a
A. humilis var. *echinata* (Willd.) Baker as *A. humilis* var. *equinata* Baker ..		14	Resende, 1937a
A. Krapohliana Marloth		14	Resende, 1937a
A. melanacantha Berger	7	14	Müller, 1945
		14	Resende, 1937a
A. brevifolia Miller		14	Resende, 1937a; Sato, 1937, 1942; Kondo & Megata, 1943; Snoad, 1951a
A. brevifolia var. *postgenita* Baker		14	Resende, 1937a
A. brevifolia var. *depressa* Baker ..		14	Resende, 1937a
A. pratensis Baker		14	Riley, 1959a
A. polyphylla Schonland		14	Riley, 1959a
A. glauca Miller		14	Resende, 1937a
A. lineata (Ait.) Haw.	7	14	Müller, 1941, 1945
A. lineata var. *Muirii* (Marloth) Reynolds as *A. Muirii* Marloth		14	Resende, 1937a
A. variegata L.	7	14	Kondo & Megata, 1943
		14	Resende, 1937a; Sato, 1937, 1942; Snoad, 1951a
as *A. ausana* Dinter		14	Resende, 1937a
A. saponaria (Ait.) Haw.		14	Taylor, 1925a, 1925b; Resende, 1937a; Sato, 1937, 1942; Snoad, 1951a
as *A. latifolia* Haw.		14	Sato, 1937, 1942
as *A. macracantha* Baker	7	14	Johansen, 1929
as *A. macrantha*		14	Suto, 1936, attributed to Johansen
A. saponaria (var. ?)		14	Resende, 1937a, 1937b
A. Davyana Schonland		14	Kondo & Megata, 1943; Riley, 1959a
A. Davyana var. *subolifera* Groenewald	7	14	Müller, 1945
A. Verdoorniae Reynolds		14	Riley, 1959a
A. mudenensis Reynolds		14	Riley, 1959a
A. Greenii Baker	7	14	Müller, 1945
		14	Resende, 1937a; Snoad, 1951a
A. Dyeri Schonland	7	14	Müller, 1945
A. pruinosa Reynolds	7	14	Müller, 1941, 1945
A. Fosteri Pillans	7	14	Müller, 1945
		14	Riley, 1959a
A. Vogtsii Reynolds	7	14	Müller, 1945
A. Lettyae Reynolds	7	14	Müller, 1941, 1945
A. longibracteata Pole Evans		14	Resende, 1937a, 1937b; Riley, 1959a

Species or variety	*n* no.	2*n* no.	Authorities
A. barbertoniae Pole Evans			
as *A. Barbertonia* Pole Evans ..		14	Resende, 1937a
A. deWettii Reynolds	7	14	Müller, 1945
A. transvaalensis O. Kuntze			
as *A. laxissima* Reynolds	7	14	Müller, 1941, 1945
A. parvibracteata Schonland		14	Riley, 1959a
as *A. pongoloensis*		14	Resende, 1937a
A. Simii Pole Evans	7	14	Müller, 1945
A. zebrina Baker	7		Fernandes, 1931; Kondo & Megata, 1943
		14	Fernandes, 1930; Resende, 1937a
A. grandidentata Salm Dyck	7		Marshak, 1934
		14	Resende, 1937a
A. striata Haw.	7		Sax (in Marshak, 1934); Kondo & Megata, 1943; Müller, 1945
		14	Resende, 1937a, 1937b; Müller, 1945; Riley, 1959a
as *A. Hanburyana* Naud. (*A. striata* Haw.)		14	Müller, 1912
A. karasbergensis Pillans		14	Riley, 1959a
A. suprafoliata Pole Evans	7	14	Müller, 1941, 1945
A. pretoriensis Pole Evans	7	14	Müller, 1941, 1945
		14	Resende, 1937a
A. claviflora Burchell		14	Riley, 1959a
as *A. Schlechteri* Schonland ..		14	Resende, 1937a., 1937b
A. hereroensis Engl.	7	14	Müller, 1941, 1945
		14	Resende, 1937a; Riley, 1959a
A. rubrolutea Schinz	7	14	Müller, 1941, 1945
		14	Resende, 1937a; Riley, 1959a
A. cryptopoda Baker	7	14	Müller, 1945
		14	Riley, 1959a
as *A. Pienaarii* Pole Evans ..	7	14	Müller, 1945
		14	Resende, 1937a
A. Wickensii Pole Evans	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. Wickensii var. *lutea* Reynolds ..	7	14	Müller, 1941, 1945
A. Chabaudii Schonland	7	14	Müller, 1945
		14	Riley, 1959a
A. tenuior Haw.	7	14	Müller, 1945
		14	Resende, 1937a; Snoad, 1951a; Riley, 1959a
A. tenuior var. *rubriflora* Reynolds ..	7	14	Müller, 1941, 1945
A. tenuior var. *decidua* Reynolds ..	7	14	Müller, 1945
A. ciliaris Haw.	21		Müller, 1941
	21	42	Müller, 1945
	25		Gioelli, 1930
		42	Resende, 1937a; Snoad, 1951a; Riley, 1959a
		45	Ferguson, 1926
A. Tidmarshii (Schonl.) Müller ..	7	14	Müller, 1945
as *A. ciliaris* var. *tidmarshii* Schonl.		42	Snoad, 1951a
A. gracilis Haw.			

Species or variety	*n* no.	2*n* no.	Authorities
as *A. laxiflora* N. E. Brown ..	7	14	Müller, 1941, 1945
		14	Resende, 1937a
A. commixta Berger		14	Snoad, 1951a
A. striatula Haw.	7		Fernandes, 1931; Müller, 1941, 1945
		14	Fernandes, 1930; Resende, 1937a; Müller, 1941, 1945; Snoad, 1951a; Riley, 1959a
A. *Pearsonii* Schonland		14	Resende, 1937a
A. mitriformis Miller		14	Riley, 1959a
as *A. mitriformis* Haw.		14	Resende, 1937a, 1939
as *A. parvispina* Schonland ..		14	Resende, 1937a
as *A. mitriformis* var. *Commelinii* Baker		14	Resende, 1937a, 1941
as *A. mitriformis* var. *spinulosa* Baker		14	Resende, 1937a
as *A. mitriformis* var. *flavispina* Baker		14	Resende, 1937a
A. Comptonii Reynolds		14	Riley, 1959a
A. comosa Marloth et Berger		14	Riley, 1959a
A. succotrina Lam.		14	Resende, 1937a; Riley, 1959a
as *A. purpurascena* Haw.		14	Resende, 1937a
A. microstigma Salm Dyck		14	Resende, 1937a; Riley, 1959a
as *A. Juttae* Dinter		14	Resende, 1937a
as *A. Brunthaleri*	7		Propach, 1934
as *A. Brunthalerii*		14	Resende, 1937a
A. framesii L. Bolus		14	Riley, 1959a
A. arborescens Miller	7		Gioelli, 1930; Kondo & Megata, 1943; Müller, 1941, 1945
		14	Taylor, 1925a; Ferguson, 1926; Gioelli, 1930; Resende, 1937a; Müller, 1941, 1941, 1945; Snoad, 1951a
as *A. arborescens* var. *natalensis* Berger	7	14	Ferguson, 1926
		14	Resende, 1937a
A. pluridens Haw.	7	14	Ferguson, 1926; Müller, 1945
		14	Resende, 1937a
A. mutabilis Pillans	7	14	Müller, 1941, 1945
A. speciosa Baker		14	Resende, 1937a; Sato, 1937, 1942; Riley, 1959a
Sec. 5 Anguialoe Reynolds:			
A. castanea Schonland	7	14	Müller, 1945
Sec. 6 Pachydendron Haw.:			
A. globuligemma Pole Evans	7	14	Müller, 1941, 1945
		14	Resende, 1937a, 1937b; Riley, 1959a

Species or variety	n no.	2n no.	Authorities
A. aculeata Pole Evans	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. petricola Pole Evans		14	Riley, 1959a
A. Reitzii Reynolds	7	14	Müller, 1941, 1945
		14	Riley, 1959a
A. Gerstneri Reynolds	7	14	Müller, 1945
A. ferox Miller	7		Fernandes, 1931; Kondo & Megata, 1943
		14	Fernandes, 1930; Resende, 1937a; Sato, 1937, 1942; Riley, 1959a
as *A. supralaevis* Haw.		14	Resende, 1937a
A. angelica Pole Evans		14	Riley, 1959a
A. rupestris Baker	7		Riley, 1959a
A. Thraskii Baker	7	14	Müller, 1941, 1945
as *A. Thraskii* de Wildeman ..		14	Resende, 1937a
A. Marlothii Berger		14	Resende, 1937a; Riley, 1959a
Sec. 7 Dracoaloe Berger:			
A. ramosissima Pillans		14	Riley, 1959a
A. dichotoma Masson		14	Riley, 1959a
as *A. dichotoma* L. E.		14	Resende, 1937a
Sec. 8 Aloidendron Berger:			
A. Bainesii Th. Dyer		14	Resende, 1937a
Sec. 10 Kumara Medic:			
A. plicatilis (L.) Miller	7		Fernandes, 1931
		14	Fernandes, 1930; Resende, 1937a; Snoad, 1951a; Riley, 1959a

Horticultural Forms

Species or variety	n no.	2n no.	Authorities
A. arborescens var. *frutescens* Link ..		14	Resende, 1937a

Putative Hybrids

Species or variety	n no.	2n no.	Authorities
A. arborescens Mill. × *A. chortilirioides* Bgr.	7	14	Müller, 1945
A. arborescens × *A. ferox* (= *A. caesia* S. D.)		14	Gioelli, 1930; Resende, 1937a
A. arborescens × *A. ferox* (= *A. Salmdyckiana* Schult.)	7		Fernandes, 1931
		14	Fernandes, 1930; Resende, 1937a
A. bortiana		14	Sato, 1937, 1942
A. ferox var. *Galpini* Ret. × *A. microstigma* S. D.	7	14	Müller, 1945
A. globuligemma × *A. castanea*	7	14	Müller, 1945
A. humilis × *A. spinosissima* Hort. ..		14	Fernandes, 1930, 1931; Resende, 1937a
A. × *Paxii* Terraciano f.	7		Fernandes, 1931
		14	Fernandes, 1930; Sato, 1937, 1942
A. runcinata Berger		14	Resende, 1937a

Species or variety	*n* no.	2*n* no.	Authorities
as *A. obscura* Berger (non Miller)		14	Resende, 1937a
A. saponaria × *A. macracantha* ? ..		14	Mendes, 1950
A. × *Schimperi* Todaro		14	Resende, 1937a; Snoad, 1951a
	7	14	Afify, 1945
as *A. schumperi*		14	Sato, 1937, 1942
A. speciosa × *A. striata*		14	Resende, 1937a
A. speciosa × *A. supralaevis*		14	Resende, 1937a
A. × *spinosissima* Hort.) (= *A. humilis* var. *echinata* × *A. arborescens* var. *pachythyrsa*)		14	Fernandes, 1930; Resende, 1937a; Snoad, 1951a
A. spuria Berger		14	Sato, 1942
A. striata × *A. saponaria*		14	Resende, 1941
A. striata × *A. Schimperi*		14	Resende, 1937a
A. striata × *A.* sp. (?)	7		Kondo & Megata, 1943
A. Todari var. *praecox* Borzi	7		Gioelli, 1930
as *A. Zodari* var. *praecox*	7		Suto, 1936, attributed to Gioelli (1930)
A. × *Winteri* Berger	7		Fernandes, 1931
		14	Fernandes, 1930

Species Found in Countries other than South Africa

Species or variety	*n* no.	2*n* no.	Authorities
A. abyssinica Lam. (Eritrea)	7		Ferguson, 1926
A. andringitensis H. Perrier (Madagascar)		14	Resende, 1937a
A. Beuttnerii Berger (Togo)		14	Resende, 1937a
A. bulbillifera H. Perrier (Madagascar) ..		14	Resende, 1937a
A. Cameronii Hemsl. (Uganda ?) ..	7		Ferguson, 1926
	7	14	Müller, 1945
A. capitata var. *typica* (Madagascar) ..		14	Sato, 1937, 1942
A. ciliaris f. *gigas* Resende (= *A. gigas* Res.) (Coimbra Bot. Garden) ..		35	Resende, 1938
A. concinna Baker (Zanzibar)		14	Resende, 1937a
A. confusa Engler (Tanganyika)	7	14	Müller, 1945
A. eru Berger (Eritrea)		14	Resende, 1937a
A. lateritis Engler (Tanganyika)		14	Resende, 1937a
A. litoralis (Angola)	7	14	Koshy, 1937
A. macrocarpa (Eritrea)		14	Sato, 1937, 1942
A. madecassa H. Perrier (Madagascar) ..		14	Resende, 1937a
A. percrassa Todaro (Eritrea)	7		Fernandes, 1931
		14	Fernandes, 1930; Resende, 1937a
A. Steudneri Schweinfurth (Eritrea, Abyssinia)		14	Resende, 1937a
A. vera L. (Madeira, Canary Is., Cape Verde, India)	7		Marshak, 1934; Joshi, 1937
		14	Sutaria, 1932
as *A. vera* Miller		14	Resende, 1937a
A. vera var. *chinensis* Bak. (= *A. chinensis* Bak. ?) (East Indies)		14	Resende, 1937a
A. vera var. *chinensis* Haw. (East Indies)	7		Kondo & Megata, 1943

Species and Varieties not in Reynolds (1950), not Jacobsen (1954)

Species or variety	*n* no.	2*n* no.	Authorities
A. bergeriana Dinter		14	Resende, 1937a
A. coccinea ?		14	Snoad, 1951a
A. cristata	7		Ferguson, 1926

Species or variety	n no.	2n no.	Authorities
A. cristula (= *A. cristata* ?)	7		Suto, 1936, attributed to Ferguson, 1926
A. grandis	7		Ferguson, 1926
A. longifolia Haw.		14	Snoad, 1951a
A. mitriformis var. *typica*		14	Resende, 1937a
A. Strausii Berger	7		Fernandes, 1931
		14	Fernandes, 1930
A. stricta (misspelling for *A. striata* ?)		14	Sato, 1937, 1942
A. tenuifolia Lam.		42	Snoad, 1951a
A. Varvarii	7	14	Gioelli, 1930
UNIDENTIFIED PLANTS			
A. sp. (J. Brown, Southall)		14	Snoad, 1951a
A. sp. (5 plants)		14	Resende, 1937a
A. sp. (23 plants)		14	Snoad, 1951b
A. sp. (1 plant)	7	14	Mendes, 1950
A. sp. (1 plant)		14	Riley, 1959a
A. sp. (1 plant)		35	Snoad, 1951b
A. sp. (4 plants)		42	Snoad, 1951b

A NEW SPECIES OF LEUCOSPERMUM

By H. B. Rycroft

(*National Botanic Gardens of South Africa, Kirstenbosch*)

(With Plates XXIII and XXIV)

Leucospermum arenarium Rycroft sp. nov. (§ Hypophylloidea); affinis *L. hypophyllum* R. Br. sed bracteae longo-acuminatae.

Frutex 2 m. altus. Rami procumbente, tomentosi et villosi. *Folia* 3—5 cm. longa, 3—7 mm. lata, lineari-oblanceolata, subdistincte venosa, tomentosa et deciduo-pilosa, apice obtusa, superne 1—3 calloso-dentata. *Capitula* terminalia solitaria vel 2—3, pedunculata, 2—5 cm. longa, pedunculo 1—3 cm. longo. *Bracteae* longo-acuminatae, apice subulato-acuminatae, dense tomentosae vel adpresso-pubescentae, ciliatae. *Tubus calycis* 1 cm. longus, glaber; lobi 5—7 mm. longi pubescentes vel tomentosi. *Antherae* 3 mm. longae, ovato-lanceolatae, sessiliae. *Stylus* curvatus, angularis, glaber; stigma 2 mm. longum.

CAPE PROVINCE. PIKETBERG DIVISION: Between Redelinghuis and Aurora, *Rycroft* 2125 (type) and *Thomas* s.n. in Compton Herbarium, Kirstenbosch. Collected, August 1958.

Small shrub up to 1 m. high with ends of branches trailing on the ground.

Branches tomentose and pilose, terete.

Leaves loosely scattered on erect branches and all turning skywards on procumbent branches, linear-oblanceolate, gradually attenuate towards the base, sessile, 3—5 cm. long, 3—7 mm. broad, widest above the middle, obscurely veined, tomentose with deciduous scattered pilose hairs; margin flat or slightly involute; apex obtuse with 1—3 callous teeth.

Heads mostly solitary, terminal, or in terminal pairs, or with a terminal head and a second or third head borne laterally, peduncled, with an involucre of barren bracts, about 2·5 cm. long excluding the styles; peduncles bent upwards, 1—3 cm. long, bearing bracts similar to the involucral bracts.

Receptacle conical 5—10 mm. long, 5—10 mm. broad.

Involucral bracts. Outermost long-acuminate with a subulate-acuminate apex, broadest at the base and tapering evenly to the apex, tomentose on the back, margins ciliate; inner ovate with an abrupt long-acuminate apex, 1—1·5 cm. long, densely tomentose or adpressed pubescent at the base becoming more or less glabrous towards the apex, margins ciliate.

Floral bracts oblong-obovate with an abrupt acuminate apex, about 1·5 cm. long, becoming smaller inwards, densely white adpressed hirsute towards the base, margins ciliate: smaller, barren bracts occur on the apex of the receptacle.

Perianth 2 cm. long; perianth tube 1 cm. long, cylindric, glabrous or with a few hairs at the apex; adaxial and lateral claws united into a sheath, coiled back at the apex, 5—7 mm. long, pubescent on the free margins of the lateral claws; abaxial claw pubescent on back and margins, coiled back at the apex; limbs oblong-lanceolate, boat-shaped, pubescent or tomentose on the back, up to 5 mm. long, coiled back on the sheath: anthers 3 mm. long, sessile, ovate-lanceolate.

Pistil up to 3·5 cm. long, S-shaped, glabrous, somewhat angular, gradually tapering from the base; stigma cylindric, 2 mm. long, thicker than the apex of the style.

L. arenarium differs from other species of the section Hypophylloidea in having decidedly curved styles, long-acuminate apices to the involucral and floral bracts, a more lax inflorescence, a different habit, and in other minor characters.

This new Leucospermum was brought to my notice by Mrs. M. L. Thomas, who discovered it in the northern part of the Piketberg Division of the Cape Province in 1958. Subsequent investigation has indicated that it occurs on either side of the road between Redelinghuis and Aurora, extending from about six to nine miles south of Redelinghuis.

The main stem rises from the ground and produces branches which eventually trail, forming a bush about six feet in diameter. The heads which are yellow or orange, fade to a reddish tinge and are produced just above ground level at the ends of the branches round the perimeter of the shrub.

The surrounding vegetation is typically of the "Cape Flora", and other members of the family Proteaceae growing in association with *Leucospermum arenarium* include *L. candicans* Loud, *L. puberum* R. Br., *Serruria adscendens* R. Br., *S. fucifolia* Knight, *Protea laurifolia* Thunb. (*P. marginata* Thunb.) and *Leucadendron pearsoni* Phillips.

PLATE XXIII. *Leucospermum arenarium* Rycroft.

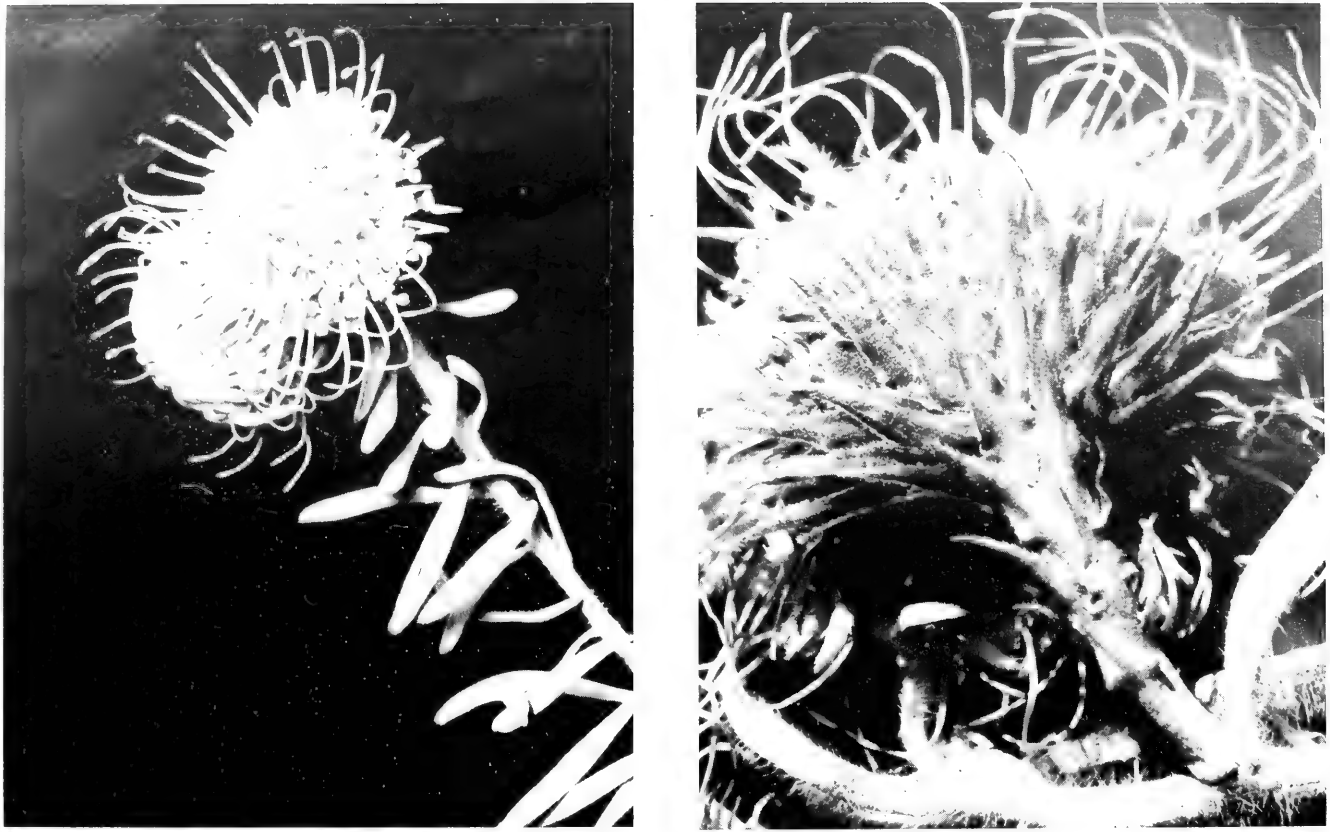

PLATE XXIV. *Leucospermum arenarium* Rycroft.

Left: A branch with two heads. *Right:* Dried specimen showing long-acuminate bracts.

Throughout its distribution it grows in soil of a sandy nature, derived mainly from Table Mountain Sandstone.

It appears that the species had not been collected previously because no specimens were to be found in the Compton and South African Museum Herbaria at Kirstenbosch, the Bolus Herbarium or the National Herbarium, Pretoria incorrectly placed in the section Hypophylloidea nor among the "species novae" or "incertae".

Young seedlings transferred to Kirstenbosch from their natural habitat in 1958 are thriving and cuttings taken from branch-tips have been established successfully. Specimens of this new species can therefore be expected to flower at the National Botanic Gardens of South Africa, Kirstenbosch, within the next two to three years

NOTES ON MESEMBRYANTHEMUM AND ALLIED GENERA

By H. M. L. Bolus

Conophyllum hallii.—Rami plures plantae ferae ramulos florentes ferentes visi, et etiam planta integra senectissima robusta, sine floribus, per menses 15 culta, demum ramos floriferos cultos, per annos 1956–1958 productos, ferens; planta 23 cm. alta; caulis basi 2 cm. diam.; rami primarii ad 1·5 cm. diam., copiose ramulosi, ramulis ultimis lateralibus multis, reliquiis crebris persistentibus vestitis, saepe 2—3 cm. longis, 3—5 mm. diam.; folia primaria fera ad 2·2 cm. longa, basi 6 mm. lata, culta 4—4·5 cm. longa cum vagina ad 5 mm., basi 1—1·2 cm. lata, supra visa acuta vel subobtusa, lat. visa apice rotundata vel oblique rotundata; secundaria fera ad 1·2 cm. longa, vagina 3 mm. longa, culta 3·5—4 cm. longa, vagina 2—2·5 cm., vel rarius tantum 1·5 cm., longa, partibus liberis saepe divergentibus, lat. visis apice rotundatis; tertiana fera 9—11 mm. longa, culta ad 2·2 cm. longa cum vagina 2 mm., dorso inferne rotundata, superne carinata, lat. visa superne non angustata, apice obtusa vel abrupte acuta; pedunculus ferus 4—5 mm., cultus 1—1·7 cm., longus; receptaculum obconicum, ferum 4—5 mm. longum, 6—8 mm. diam., cultum 5—7 mm. longum, 7—9 mm. diam.; sepala 5, fera 6—8 mm., culta saepius 1—1·7 cm. longa, exteriora obtusa, interiora supra medium subulata; petala culta ca. 4-seriata (interiora pauca), e prope medium inferne angustata, obtusa lutea, 0·5—2 cm. longa, ad 2·5 mm. lata; stamina pallide lutea vel alba, ad 7 mm. longa; ovarii lobi subdistantes, obtuse compressi, ad 1·5 mm. elevati; stigmata gracilia, 8—10 mm. longa; capsulae senectae tantum visae sed tamen cum genere conveniunt.

Cape Province: Namaqualand; Richtersveld, Numees Mine, "numerous on slope of hill amongst *Pachypodium namaquanum*", Sept. 1953, *H. Hall* (N.B.G. 696/53). Fl. Jul.—Aug. 1956—1958.

Conophytum intrepidum (*Euconophytum*).—**C. obscuro** N. E. Br. (*flores typi ignoti*) affine, sed corpusculis late obconicis, apice pubescentibus differt.

Plantae ferae multae visae, "in situ caespites permagnas (ad 200 corpuscula) formantes (an plantae singulae vel aggregatae ?)"; radix 2—3 mm. diam.; vaginae persistentes dense imbricatae, ad 16 in ramo visae, papyraceae, inferiores saturate cinereo brunneae vel brunneae, superiores

pallidiores, supremae albidae; corpuscula saepius basi subrotundata, superne gradatim ampliata itaque late obconica, ad 1·1 cm. longa, ad 1 cm. lata diametroque, supra visa circularia, plana minuteque papillata, papillis saepissime minutissime setiferis, setis cum aetate saepe elongatis itaque pubescentiam mollem formantibus, ore pubescente, 1—2 mm. longo; flores diurni; pedunculi 2—5 mm. longi, bracteis basi positis, late obtusis vel subtruncatis, ultra medium connatis, sinu excavato, 1·5—3 mm. longis; calyx 4-nervatis, nervis viridibus, 4—6 mm. longus, tubo membranaceo, ad 5 mm. longo, segmentis 4, subaequilongis herbaceis, late membranaceo marginatis; corolla 1·5—2·5 cm. longa, tubo superne leviter ampliato, inferne pallido, superne aureo, 6—13 mm. longo, segmentis 2—3-seriatis, intimis paucis vel deficientibus, inferne saepe vix angustatis, apice rotundatis vel subtruncatis emarginatisque, purpureo roseis, exterioribus subaequilongis, 0·25—1·75 mm., vel rarius ad 2 mm., latis; stamina 22—30, 3—4-seriata, fere omnia exserta, filamentis superioribus aurantiacis, antheris pollineque laete luteis; discus sat inconspicuus, obscure crenulatus; stylus 8—13 mm. longus, stigmatibus 1·5—3 mm. longis.

Cape Prov.: Namaqualand; "summit of Augrabies hills, alt. about 1,600 ft.", March 1958, *H. Hall* 1362. Fl. Nov.—Dec. 1958. N.B.G. 164/58.

C. obscurum N. E. Br., described in 1927, is an imperfectly known species. It was not in flower when collected by R. Marloth on the Augrabies hills in September 1925. The type-number is represented in the Bolus Herbarium by a branch bearing six bodies with the current year's growth still plainly visible, the epidermis of the apex being glabrous and polished and quite unlike that of **C. intrepidum** L. Bol., to which it seems to be more closely allied than to any other **Conophytum** recorded from these hills. Mr. Hall in his two previous visits to Augrabies had noted five species, including his recent discovery of **C. barbatum,** and on this memorable day, March 30, 1958, when he set out alone to make for the summit, he met them all once more: "the larger yellow bilobed Conophytum very, very shrivelled up, but flowering gaily, which proves that some species will flower when the time comes without waiting for the rain; then 3 species, **C. barbatum, C. marlothii*** and **C. minutiflorum,** all happily mixed

* **C. marlothii** N. E. Br. was collected without flowers and was later sunk in **C. fraternum** N. E. Br. by its author. The collection made by H. Hall represents the second record from the type-locality, and exactly agrees with the type-description, as far as this goes. It also matches the portion of the type of **C. doornense** N. E. Br. in the Bolus Herb. which is figured in our "Notes" (Part III, Plate 40, C.) In our opinion **C. marlothii** should be retained with **C. doornense,** published later, as a synonym. We have not, however, been able to see the type-material of **C. fraternum.**

together and so much resembling one another that I had to pull off the dried skins to reveal their features; and the fifth species, the fuzzy looking **C. stephanii** growing, wisely, always in the shade".

Having reached the summit there was a pause to admire the extensive views: "To the west I could see the grey fog-enshrouded coast, to the south the gradual slope of the hills till they disappeared in red sand towards Groot Mist, and to the east and north the mountains of the Richtersveld lay basking in the sunshine and fading into the purplish distance". What a prelude to the thrill that was awaiting the collector!

To continue Mr. Hall's account from which I have been privileged to quote extracts: "The summit was fairly flat, sandy and bush-covered and not quartz-strewn as I had hoped, but nevertheless crowded with interesting and varied plants to which I could only give a passing glance, and recognize old friends like Meyerophytum, Leipoldtia plana and Ruschias. For my goal was the rim-like edge of the escarpment, which I found even more precipitous than it had appeared to be from below, especially the portion where a vertical cliff-like face runs for about a mile, with a sheer drop of hundreds of feet in places. It consisted of horizontal strata rather like slabs of crazy pavement, overhanging, some perilously loose. Discarding all impedimenta and after a little exploration, I found I could descend below the rim on the *east* side for about 6 feet to a narrow ledge where, hanging on like grim death with one hand and extricating plants with the other, I found almost every inch of space being occupied by small succulents. Among them was the *sixth** species of Conophytum, filling crevices or hunched into the angular pockets, and forming huge fungus-like slabs on which the soil trickled down, enriching them and encouraging better growth. *This* was totally different from all the others, and unlike any other species of the genus I have seen elsewhere. Many scores of plants were visible along the 20 feet, or less, of the horizontal traverse I could make, and no other species of Conophytum grew in the small area I was able to examine. (But who knows what may occur on the rest of the comparatively vast area of that eastern wall, where only the smaller birds, and the still smaller creatures they feed on, can find a foothold?) The plants were not in flower and were still wholly invested with dry skins having the same concave apex as C. barbatum, but the bodies were *much* larger and the plants more compact and clump-forming. No remains of previous flowers were evident." (Exactly eight months later (Nov. 1, 1958) the first flower appeared at Kirstenbosch, to our great surprise; for this is by far the earliest date recorded of the flowering-

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* A seventh species, **C. meyeri** N. E. Br. var. **quinarium** L. Bol., was collected on a previous journey (1955) by Mr. Hall, making with **C. obscurum,** a total of 8 species of **Conophytum** recorded from Augrabies.

time of this genus. Others followed freely up to about the end of December, gradually increasing in size.)

To close this story of the discovery of **C. intrepidum,** and to make Augrabies a still more living picture to those who do not know it, two more extracts are quoted from Mr. Hall's interesting narrative: "Among the dwarf succulents sharing this lofty situation were Cotyledon schaeferi, C. bukholtziana, Crassula columella, Haworthia setata, H. tessellata, Pelargonium fulgidum, P. echinatum, Huernia namaquensis, tiny Ornithogalum spp., and above all the pigmy Gasteria which has aroused a good deal of attention from the botanists. . . . The Augrabies is a small, broken range of hills, running roughly north and south, and the last range before reaching the sea at Port Nolloth 12 miles west, their highest elevation being about 1,600 ft. The eastern slopes are sheltered from the prevailing westerly winds and are clothed with much better vegetation than the western slopes. Except for the early hours of the day much of the vertical cliff at the summit is in the shade. The average yearly rainfall is probably less than 2 inches."

Conophytum orientale (*Euconophytum*).—**C. vago** N. E. Br. valde affine, sed segmentis calycis stigmatibusque 4, petalis saepissime apice rotundatis vel obtusis, inferne angustatis, differt.

Vaginae persistentes inferne papyraceae, superne tenuiter pergamentaceae, albidae vel griseo brunneae; corpuscula obconica vel piriformia, minutissime papillata, supra sat convexa, punctis viridibus (in siccis rubris), interdum approximatis et circulum interruptum formantibus, aliter paucis sparsisque, ad 1·4 cm. longa, ad 1 cm. lata, ad 1·3 cm. diam., ore non punctato, intus infra marginem pubescente, pilis minutis, manu complanato, ad 3 mm. longo; flores nocturni; pedunculus 6—7 mm. longus, bracteis 2 mm. a basi positis, subacutis, sinu excavato, 2 mm. longis cum vagina ad 0·75 mm.; receptaculum 2 mm. longum, ad 3 mm. diam.; calyx herbaceus, 5—6 mm. longus, tubo primo in corpusculo incluso, 3—4 mm. longo, segmentis 4, subacutis subaequilongis; corolla pallidissime straminea, sicca saturior, 9—14 mm. longa, tubo 3—4 mm. longo, segmentis 3-seriatis, e supra medium inferne leviter angustatis, siccis immerse glanduliferis, ad 0·75 mm., vel rarius ad 1 mm., latis; stamina ca. 23, 3-seriata, exserta vel inferiora apicem tubi attingentia, filamentis albis, antheris pollineque pallidis; discus fere ad medium in segmenta 8, truncata, obscure crenulata, divisus; ovarium supra planum, medio tantum subconice ad altitudinem disci elevatum; stylus 0·5—1 mm. longus, stigmatibus 4, 2 mm. longis.

Cape Prov.: in dit. Willowmore; prope Steytlerville, *L. J. Hill* (N.B.G.

739/56). Fl. Feb. 1957—typus. Ibid. April 1940, *C. P. Fourie* (S.U.G. 11446).

The discovery of this close ally of **C. vagum** extends the eastern limit of the distribution of the genus for about 80 miles beyond the Kamanassie Karoo in the Uniondale Div. (where Thunberg in 1773 collected **C. truncatum**—the first species published, in 1791, of this large and ever expanding genus) and, in about the same longitude, beyond Toverwater in the Willowmore Div. (where more than 150 years later **C. peersii** was found by V. S. Peers). It is possible, or even probable, that **C. vagum** is also an eastern species. It was sent, without locality, to Kew in 1870 by P. MacOwan, who was then Professor of Chemistry at Gill College, Somerset East. It is well known that Professor MacOwan encouraged the students to collect native plants and to assist him in building up the herbarium which later, as the Gill College Herbarium, was incorporated in the Albany Museum Herbarium. It is quite likely that **C. vagum** ("the rover") was found by one of them and that, being of very special interest, the whole collection (nothing of it is preserved in the Gill College Herbarium) was dispatched as expeditiously as possible.

Mr. Hill states "that growing in close proximity, in a space of about 4 square feet, to this Conophytum were a Glottiphyllum, a Faucaria, a Pleiospilos (probably P. minus), a Crassula, a Euphorbia and an Astrolobus having a fine cluster of **C. orientale** cheek by jowl, as if attached to it for shelter. A species of Haworthia was found about a quarter of a mile away". All are now growing together on his fascinating rockery, "keeping one another company as before".

Conophytum tenuisectum (*Euconophytum—Subrisa*).—Planta 9 cm. et 11 cm. diam., e 35 corpusculis composita; rami omnino vaginis persistentibus vestiti, sine ortu hornotino ad 3·5 cm. longi; corpuscula, etiam florentia, in vagina omnino inclusa, itaque majora non plene expansa, vagina pergamentacea, supra albida vel pallide brunnea, lateribus brunneis, conspicue notatis, notis crebris, saturate brunneis, obconica vel late obconica, interdum subobliqua, pallide viridia, ad 1·6 cm. longa, 1·5 cm. lata diametroque, ore in lineam strictam disposito (i.e. labiis non prominentibus), in foveam terminantem, ad 5 mm. longo; flores vespertini nocturnique suaveolentes; pedunculi 3—5 mm. longi, bracteis basalibus acutis papillatis, ad medium coalitis, sinu excavato, 2—3 mm. longis; receptaculum subglobosum, 2 mm. longum, ad 3 mm. diam.; calyx primum herbaceus, mox siccans rubescensque, 6—7 mm. longus, tubo 4—5 mm. longo, segmentis 6, subaequilongis; corolla 2·5—3 cm. longa, tubo saepius cylindrico, albo, 9—12 mm. longo, segmentis 3—4-seriatis, laxissimis, inferne vix angustatis, acuminatis vel acutis, luteis

(siccis aureis vel aurantiacis, saepius 0·25—0·5 mm. latis; stamina pluriseriata, seriebus inferioribus 3—4 inclusis, superioribus exsertis, filamentis albis, 1—4 mm. longis, antheris pollineque stramineis; discus ca. 0·5 mm. altus, segmentis truncatis brevibus; ovarium supra conicum, lobis levissime compressis, ad 0·75 mm. elevatis, stylo brevissimo (an ovarii apex ?), stigmatibus 6, sat gracilibus, superne vix angustatis, 2 mm. longis.

Cape Prov.: in dit. Calvinia; Loeriesfontein, Oct. 1956, *L. J. Hill* (N.B.G. 761/56). Fl. libere Feb.—Mar. 1959.

Loeriesfontein and Pofadder (the type-locality of **C. vanzylii** Lavis) are the most easterly stations recorded for this section (*Subrisa*) in the Cape Province. The latitude of the former is slightly north of that of Bitterfontein and still farther north than that of Atties (the type-locality of **C. subrisum** (N. E. Br.) N. E. Br., but well south of that of Alwynsfontein (the type-locality of **C. longipetalum** L. Bol.) which is in about the same latitude as that of Leliefontein.

C. tenuisectum is allied to these three species, having the apex of the body similar to that of **C. subrisum,** except that there is no ridge extending from the mouth on each side to the margin, as shown in the photograph of the type (Labarre, Mesemb., p. 145, fig. 44C). *The flowers of the type are unknown.* From **C. vanzylii,** of which it has the lax corolla-segments and the conical ovary, it differs in the shape of the body, the much longer corolla with acuminate or acute segments, and the more numerous stamens. From **C. longipetalum** it is distinguished by the shape of the body, the non-protruding "lips" of the mouth, the narrower and more laxly arranged acuminate or acute corolla-segments, spreading in different planes, and the conical ovary.

Conophytum pearsonii N. E. Br. var. **latisectum** (*Euconophytum*)—Plantae 2 visae, circuitu semiglobosae, ad 9 cm. diam., ad 5 cm. altae; vaginae persistentes novellae supra albidae, inferne pallide brunneae longitudinaliterque conspicue rugosae; os intus pilosum, pilis deflexis densis; calyx 5—7 mm. longus, tubo pallido membranaceo, ad 5 mm. longo, segmentis herbaceis, omnibus membranaceo marginatis; corolla 1·5—1·8 cm. longa, tubo cylindrico, 5—7 mm. longo, segmentis 2-seriatis, inferne conspicue angustatis, acutis, ad 2 mm. latis.

Cape Prov.: Vanrhynsdorp Div.: 10 miles S. of Sout R., *H. Hall* (N. B. G. 664/57). Fl. Feb. 1959.

It is remarkable that the two closely allied species, **C. minutum** and **C. pearsonii,** whose bodies are so totally different in appearance from those of **C. minusculum** and its close allies, **C. herrei, C. reticulatum,** and **C. luckhoffii,** should have exactly the same kind of style and stigmas,

combined with the same arrangement of the short stamens enclosed in the corolla-tube, as occurs in the latter. In the course of my 60 years of herbarium-work it has been one of my chief duties to dissect and preserve, with notes, as much as possible of the living material of succulents that has been submitted for my attention, so that the evidence thus recorded might serve future monographers, and that the dried collection itself might not be considered of "little more value than a haystack". During this period hundreds of flowers of **Conophytum** have been dealt with, and the characters noted above have only been found, combined, in the 6 species mentioned here. According to Dr. Tischer's careful arrangement of the species of **Conophytum** (Jacobsen, "Handbook", III, pp. 1243—1252) **C. minutum** and **C. pearsonii** are grouped with **C. wettsteinii** and 30 other species, all having bodies of more or less the same shape, but widely differing in floral characters from the former, more especially if the conspicuous and unusual presence of "staminodes" in these 2 species be also taken into account. If the far more fundamental floral characters had been used as a basis of classification, these 3 attributes would justify the creation of a separate group for **C. minutum** and **C. pearsonii.** On the other hand there is a great deal to be said for taking external characters only in making keys designed for popular use. For flowers may be rarely produced in some countries, and a whole body of a precious Conophytum has to be sacrificed in order to examine its flower.

The recently described species, **C. nudum** Tisch. ("Kakteen", 1928, 31) is distinguished from **C. minutum** by reason of its "spotless" bodies. But this distinction cannot be upheld, because Haworth described the typical form as being "immaculate", and his plant figured in the Botanical Magazine in 1811 (t. 1376) is also immaculate. Therefore if the 2 forms are to be considered distinct species, it is the one with dots on the bodies that requires a new name.

Conophytum microstoma (*Euconophytum*)—Planta 1 visa, semiglobosa, copiose ramosa, ad 5 cm. alta, ad 9 cm. diam.; rami ramulique omnino vaginis persistentibus vestiti, itaque internodiis inclusis; vaginae dense imbricatae, in ramulis ultimis floriferis ad 8 visae, novellae inferne brunneae, superne albidae conspicueque atrate punctatae, senectae griseae, lateribus asperulis ob papillas capillaceas minutas; corpuscula piriformia, supra circularia, leviter convexa, olivacea punctata, punctis sparsis parvis, saturate viridibus, lateribus minutissime capillaceo papillatis, 1—1·2 cm. longa, 7—10 mm. diam., ore inter minima visa, leviter depresso, intus minutissime capillaceo papillato, marginibus saturatiore viridibus, 1·5 mm. longo; flores diurni; pedunculi ad 4 mm. longi, bracteis fere basalibus, per dimidium connatis, obtusis, 2 mm. longis, sinu sat lato;

receptaculum 2 mm. longum diametroque; calyx ad 8 mm. longus, membranaceus, herbaceo 4—5-vittatus, tubo ad 6·5 mm. longo, segmentis 4 vel rarius 5, omnibus marginatis, subaequilongis; corolla 1·7—2 cm. longa, tubo albo, superne leviter ampliata, segmentis 2—3-seriatis, inferne angustatis, apice saepius rotundatis, laete luteis, siccis aureis, 8—10 mm. longis, 1—1·5 mm. latis; stamina ca. 5-seriata, infima supra basim adnata, superiora exserta, filamentis cum antheris pollineque luteis; ovarium medio conice ad 0·5 mm. elevatum, altitudinem nectarii excedens; stylus luteus, 9—10 mm. longus, stigmatibus 2 mm., vel fere ad 4 mm. longis.

Cape Prov.: Namaqualand; inter Port Nolloth and Grootmist, "nearer Grootmist", Jun. 1956, *L. J. Hill* (Bolus Herb. 26712). Fl. hort. L. J. Hill. Mart.—Apr., 1959.

Conophytum luteolum L. Bol. var. **macrostigma.**—A forma typica stylo breviore, 1·5—3 mm. longo, stigmatibus longioribus, 4—5 mm. longis, praecipue differt.

Cape Prov.: Namaqualand; Komaggas, *H. Hall* (N.B.G. 395/54).

Conophytum meyeri N. E. Br. var. **quinarium.**—A forma typica segmentis calycis 5, stylo 1—6 mm. longo, stigmatibus 5, 5—6 mm. longis, differt.

Cape Prov.: Namaqualand; Augrabies, *H. Hall* (N.B.G. 960/55). Fl. Apr. 1956 and 1959.

The following data have been kindly supplied by Mr. Hall: height of largest plant in the collection 4 cm., diameter 8 cm., length of branches 3—4 cm., up to 70 bodies in a single plant.

The type (*Marloth* 6516) is represented in South Africa by a few of the persistent scales. In the original description the author remarks—"A dried flower only seen". The calyx-segments and stigmas are stated to be 4, and the measurements of the style as being 8—9 mm. and of the stigmas 1 mm.

Conophytum hillii (*Euconophytum—Picta*).—Plantae plures visae caespitosae glabrae, ad 5 cm. diam.; vaginae persistentes tenuiter pergamentaceae, lateribus pallide brunneis vel senectis cinereis vel atratis, superne cum apice saturate brunneo punctatis; corpuscula piriformia polita viridia, lateribus purpureis, apice elliptica (etiam si unicum tantum in vagina productum) convexa punctata, punctis saturate viridibus, nunc paucis inconspicuisque, nunc aggregatis dispositisque in lineam brevem, 1—2-ramosam e medio oris oriundam, aliter sparsis, paucis latera attingentibus, vel 3—4 coalescentibus, 1—2·5 cm. longa, 5—10 mm. lata, 8—15

mm. diam., ore saepius circa marginem punctato, interdum leviter ringente, inconspicue ciliato, pilis supra visis patentibus; flores 2 visi, nocturni odorati; pedunculi 4—6 mm., fructiferi 10 mm., longi, bracteis basalibus, altera acuta, altera subobtusa, 2 mm. longis; receptaculum 2·5 mm. longum diametroque; calyx herbaceus ruber, bene exsertus, 7 mm. longus, segmentis 5, obtusis vel subacutis, 2 marginatis, 2—3 mm. longis; corolla ad 1·7 cm. longa, alba, sicca pallide straminea, tubo incluso, 6 mm. longo, segmentis 20—25, 3-seriatis, laxissimis, acutis vel acuminatis, inter angustissima in genere, saepius 0·25—0·5 mm. latis; stamina ca. 20, 3-seriata, infima paulo infra medium adnata, apicem tubi attingentia vel parum ultra, filamentis albis, antheris dilute luteis, nectarium e segmentis ca. 10, integris compositum, 0·5 mm. altum; ovarium concavum, medio brevissime conice elevatum, vix altitudinem basis nectarii attingens, stylo 0·75 mm., stigmatibus 3 mm. longis.

Cape Prov.: in dit. Calvinia, Oct. 1956, *L. J. Hill* (N.B.G. 698/56) Fl. Apr. 1959.

Delosperma esterhuyseniae.—Humile, primum caespitosum vel compactum, cum aetate sublaxum, glabrum, partibus herbaceis minutissime papillosis; radix lignosa, senecta 1·5 cm. diam.; rami primarii tandem 3—5 cm. longi vel ultra, ad 3 mm. diam., reliquiis foliorum delapsorum, persistentibus per annos plures, vestiti, internodiis in vaginis inclusis vel rarius ad 1·2 cm. longis, ramulis hornotinis saepius 2, lateraliter productis, 2—4-foliatis; folia saepe fere erecta, subclavata, supra plana vel leviter concava, obtusa vel abrupte acuta, lat. visa apice rotundata, obscure carinata, carina eccentrica, vel dorso fere rotundata, 1·5—3 cm. longa, ad 4—5 mm. lata diametroque; flores solitarii meridiani; receptaculum leviter compressum, in pedunculum clavatum, 7 mm., fructiferum ad 2·6 cm., longum, gradatim abeuns, 2 mm. longum, 4 mm. diam.; sepala 5, acuta, basi 2—3 mm. lata, extima 2 e medio superne angustata leviterque compressa, ad 6 mm. longa, intima 2 e basi superne angustata, membranis amplis, ad 5 mm. longa; petala sat dense 6-seriata, nivea, exteriora ca. 3-seriata, inferne angustata, obtusa vel subacuta, 1—1·2 cm. longa, 0·75—1·5 mm. lata, interiora sat pauca, linearia acuta, 5—8 mm. longa, 0·25—0·5 mm. lata; staminodia nulla; filamenta erecta conferta nivea, ca. 5-seriata, 1—3 mm. longa, intima tantum papillata, papillis prope apicem positis, paucis, sat longis, antheris pollineque laete luteis; glandulae approximatae, leviter elevatae, crenulatae; ovarium circa marginem planum, lobis sat abrupte ad 1 mm. elevatis, obtuse profundeque compressis; stigmata 5, anguste subulata, caudata, 3 mm. longa cum cauda 1 mm.; capsula infra late obconica, 10-nervata, supra ad 3 mm. elevata, lobis valde compressis, ad 8 mm.

longa, ad 9 mm., expansa 1·3 cm., diam., alis valvae in genere angustis; semina fere circularia, pallide brunnea, 1 mm. longa vel paulum ultra.

Cap. Prov.: in dit. Uniondale; Saptokop, Kouga Mts., "on cliffs above kloof, growing in cups and crevices," alt. 2,000 ped., Nov. 1958, *E. Esterhuysen* 27953.

The specimens when collected were in flower and with fruit in various stages of ripening; but the flowers had perished in delayed transit, and the description given above is based upon a flower produced at Kirstenbosch Feb. 18. 1959. N.B.G. 643/58.

Delosperma exspersum (N. E. Br.) L. Bol. var. **decumbens.**—Plantae plures vivae visae (typus hujus speciei ex exemplis siccis descriptus est), inter gracillimas in genere; rami decumbentes ad 18 cm. elongati, internodiis sat inconspicue papillatis, saepe 1—2·5 cm. longis, 0·5—1 mm. diam.; folia erecta vel patentia, supra visa linearia canaliculata, prope apicem leviter angustata, acuta vel subobtusa, dorso rotundata, papillis crebris minutis, saepius 1—2 cm. longa, 2—3 mm. lata diametroque; flores solitarii meridiani; pedunculi saepius 1—1·5 cm., rarius ad 3·5 cm., longi; receptaculum semiglobosum, 2 mm. longum, 5 mm. diam., vel in flore majore 3 mm. longum, 7 mm. diam.; sepala 4—5, subaequilonga, extima acuta vel longe acuminata, intima obtusa, saepius 4—5 mm. longa, basi 2—4 mm. lata; petala 5-seriata, interioribus paucis truncatis, prope medium latissima, acuta vel obtusa, purpureorosea, 3, 4, 7, 8 et 10 mm. longa, 0·5—1·5 mm. lata; staminodia nulla; filamenta 4—5-seriata, erecta conferta, inferne pallide lutea, superne cum antheris pollineque aurea, ad 5 mm. longa, exteriora epapillata, intima basi papillata; glandulae 4—5, distantes, sat inconspicuae, vix ad apicem receptaculi attingentes; ovarium circa marginem concavum, lobis abrupte ad 1 mm. vel ultra elevatis, compressis; stigmata 4—5, gracilia, prope apicem angustata, 4—5·5 mm. longa.

Cape Prov.: in dit. Worcester; Hex R. Mts., Milner Peak, alt. 5,500—6,000 ped., "cliffs, southern aspect, growing on ledges and spreading over rock", Jan. 1959, *E. Esterhuysen* 28082—typus. Roodeberg (Matroosberg group), alt. 6,000 ped., "cliffs, southern aspect", Jan. 1959, *ead.* 28139a.

Sceletium regium.—In genere robustissimum visum; radix subtuberosa, 8·5 cm. longa vel ultra, ad 2·5 cm. diam.; rami primarii ad 1 cm. diam., florentes decumbentes elongati, culti ad 43 cm. longi, internodiis saepius 1·5—4·5 cm., rarius ad 6 cm., longis, ramulis lateralibus 4—10 cm. longis; folia variabilia, in eadem planta lanceolata tumque fera ad 6·5 cm. longa, 2·2 cm. lata, vel ovato lanceolata vel ovata,

acuminata vel longe acuminata, saepius paulo infra medium latissima, basim versus angustata, vel suprema interdum ampliata amplexicaulia subcordataque, demum interdum reflexa, mox emarcida, nervo medio in genere conspicuo, nervis primariis utrimque 1—2, exterioribus saepius obscuris, saepius 3—5 cm. longa, 2—3 cm. lata, vagina subnulla vel ad 3 mm. longa; flores 3-nati vel 2-ternati, culti ad 5·5 cm. diam., pedunculis intermediis feris et cultis 1—1·5 cm., vel rarius ad 3 cm., longis; receptaculum subglobosum vel subglobose obconicum, 1—1·2 cm. longum diametroque, tubo 2—3 mm. longo; sepala 5, saepe subaequilonga, extima ovata, longe acuminata, basi interdum subcordata, ad 2·8 cm. longa, basi 1·2 cm. lata, 2 intima superne subulata, ad 2·7 cm. longa (subula in genere longissima visa, ad 2 cm. longa), basi 5—9 mm., vel cum marginibus membranaceis ad 1·8 cm., lata. quintum in forma intermedium inter extima et intima; petala 3-seriata, basi per 3 mm. coalita, superne ampliata, saepe emarginata, lutea vel aurea, ad 2·5 cm. longa, 0·75—1·5 mm. lata; staminodia staminaque exteriora aurea; ovarium per 2 mm. elevatum, angulis acute compressis; stigmata 5, anguste subulata, obtusa, 2 mm. longa.

Cape Prov.: in dit. Malmesbury; Riebeeck's Kasteel, Botma's Kloof, "western aspect", Oct. 1929, *Pillans* (Bolus Herb. 19182)—"growing in full sunshine". In dit. Picketberg, "in declivibus montis Piquetberg pone pagum, alt. 1,000 ped.," Oct. 1892, *Bolus* 8443, *Guthrie* 2605. In dit. Clanwilliam; Pakhuis Pass, Sept. 1925, *Leipoldt* (Bolus Herb. 19914—typus); Bulshoek, Oliphant's R., Sept.—Oct., 1948 et 1955, *H. Hall* (N.B.G. 807/55).

A drawing of the upper part of a flowering branch, showing the varied leaf-shapes of the type of this handsome species, was published in 1928 in our "Notes" (Part I, p. 92, fig. 19A, 1—4). At that time it was identified with *M. varians* Haw., established in 1803 (Misc., p. 51), and based upon an old figure published in Petiver's Gazaphylacium (1702–1709), t. 78, fig. 10, together with the following brief description: "Ficoides capensis folio late acuto flore albo intus luteo". Haworth's description is considerably longer and seems to include the plant of which only the upper portion of two flowering branches and a few of the upper leaves are portrayed in an unpublished drawing in the Kew Herbarium entitled *M. varians* Haw. (A tracing of this drawing is in the Bolus Herbarium, bearing no date.)

No dried material of this plant is known and no description of the veining in the skeleton-leaf is given, so that we have been unable to determine its alliance. At this stage of our knowledge of **Sceletium** it therefore seems best to regard *M. varians* as an insufficiently known species and, disregarding our former identification, to create a new species described

from ample living material exhibiting characters which, with the yellow or golden colour of the petals, make it one of the most striking and distinct species in the genus.

(*To be continued.*)

BOOK REVIEW

Nomenclature of Plants. A text for the application by the Case Method of the International Code of Botanical Nomenclature, by Harold St. John. Ronald Press Co., New York, 1958. 157 pp. $2.50. Paper cover.

Discussion which frequently takes place amongst experienced systematists on the interpretation of the International Code of Botanical Nomenclature illustrates that the "Rules" are not always perfectly understood. They are mastered only after repeated application of selected problems in a special field of study and cannot be learned otherwise.

The University student or young botanist is therefore at a decided disadvantage. Professor St. John, however, has given them copious material to come to grips with the main principles and has provided material for the application of the laws of botanical nomenclature.

In this book no less than 958 "cases" are presented for investigation. Under each, various names including synonyms are listed with the relevant publications. The student then is required to consult these references and to decide for himself which of the names is the correct one. The "cases" have been selected in such a way that all the articles and recommendations of the "International Code" are incorporated.

Apart from providing numerous exercises for nomenclatural research, the book presents valuable references to the most important publications required for systematic work.

H. B. Rycroft.

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OBSERVATIONS ON THE DISTRIBUTION AND ECOLOGY OF ORCHIDACEAE IN THE MUIZENBERG MOUNTAINS, CAPE PENINSULA.

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I. INTRODUCTION.

Ecological data on South African Orchidaceae is as yet rather fragmentary, being mostly in the form of notes on habitats of species in taxonomic monographs. An attempt is made in this paper to examine the relation between ecological factors and the distribution of orchids within a specified area.

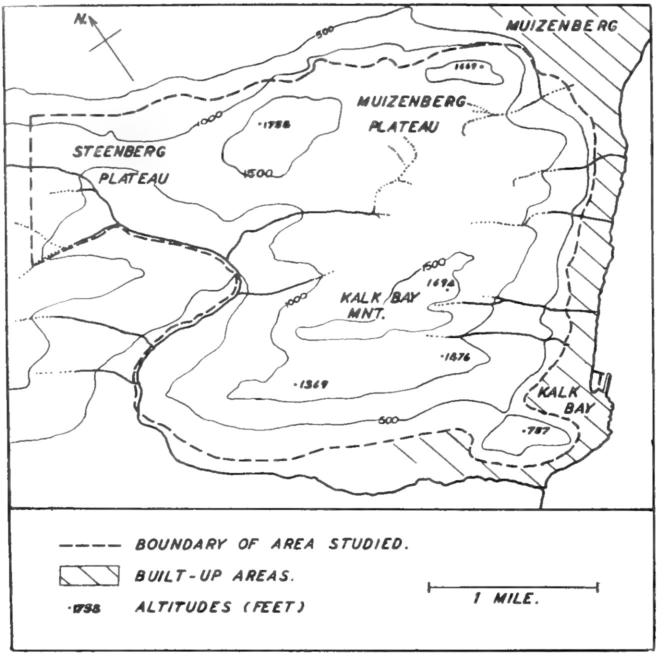
The nomenclature used is according to Lewis' treatment in the Flora of the Cape Peninsula (1950).

Topography and Soils.

The area selected for this investigation lies in a mountainous tract midway along the Cape Peninsula. A good deal of the area studied lies above 1,000 feet, with some points over 1,600 feet in altitude (Map. I). A relatively large proportion of the slopes face north-east and south-west, especially in steeper parts (Fig. 1). Very steep north-west slopes are rare.

Soils are typically sandy, predominantly derived from Table Mountain sandstone. Much of the terrain is rocky with boulder-strewn slopes and occasional broken cliffs. On south-facing slopes many of the ledges

and soil-filled crevices in these cliffs are kept moist for the greater part of the year by seepage. Perennially moist soils are also found in parts of the two plateaux included in the area.



Map I.—Showing extent and topography of the area studied.

Climate.

The Cape Peninsula lies in an area receiving rainfall in winter, a season in which north-westerly winds prevail. In summer, south-easterly winds cause mists to gather against higher slopes for periods of several days. The mists rarely descend below 800 feet above sea-level.

The early experiments of Marloth (1905) show that considerable amounts of moisture are deposited by these mists. However, Marloth's experiments were carried out near the summit of Table Mountain. As the highest points in the Muizenberg mountains are about 1,800 feet lower in altitude, dense mists which, according to Marloth, cause by far the greater amount of deposition, are rather less frequent.

Rainfall has been recorded at three places near the area under investigation (Table I).

TABLE I.

Rainfall near the Muizenberg Mountains.

Locality	Alt. (M.)	No. of years averaged.	Ann. av. (mm.).	Max. (mm.).	Min. (mm.).
Tokai, 1½ miles north of area	56	64	966·2	1586·2	590·3
Muizenberg reservoir at N.E. tip of area	91	44	1285·7	1954·0	867·2
Fish Hoek, ½ mile south of area	15	6	735·3	887·0	569·5

VEGETATION.

The vegetation is typical South-Western Cape sclerophyll, having a predominance of small-leaved shrubs and reed-like Restionaceae. Small patches of evergreen forest are found in sheltered kloofs. The vegetation has been subjected to intermittent burning for many years and as a result dense cover is uncommon.

II. DISTRIBUTION OF SPECIES.

RECORDING METHODS.

To obtain adequate distribution data, an area of five square miles was used. All localities were recorded as co-ordinates of a grid with units measuring 220 x 220 yards, drawn to scale on a 1 : 17,000 contour map of the area. Where local habitat variation was great the grid units were divided into 25 sub-units, with corresponding sub-co-ordinates.

Habitat notes were made at each locality where orchids were found, together with estimates of the number of plants present of each species. Locality and frequency data were later plotted on maps of the above scale to show the distribution of each species throughout the area.

Grid units were systematically examined at least twice during the flowering season. In addition, a large number of localities were known to the author before 1955, when the distribution patterns were plotted.

DISPERSAL.

The distribution data can be considered from two viewpoints: firstly, dispersal throughout a large area (Table II); and, secondly, dispersal within small units of the area (Table III).

TABLE II.

List of species in descending order of dispersal, based on the number of grid units occupied by a species. The number of observed individuals is appended for rare species.

Species.	*No. of grid units containing at least one individual.*
Satyrium bicorne (L.) Thunb.	101
Satyrium odorum Sond.	64
Disperis capensis (L.f.) Sw.	57
Holothrix villosa Lindl.	46
Pterygodium catholicum (L.) Sw.	45
Monadenia micrantha Lindl.	33
Liparis capensis Lindl.	28
Herschelia graminifolia (Ker.) Dur. & Sch.	25
Satyrium saxicolum Bolus	23
Holothrix condensata Sond.	22
Disa maculata L.f.	17
Holothrix squamulosa Lindl.	17
Penthea patens (L.f.) Lindl.	16
Satyrium bicallosum Thunb. var. ocellatum Bolus	13
Satyrium coriifolium Sw.	13
Acrolophia Bolusii Rolfe	13
Orthopenthea rosea (Lindl.) Rolfe	12
Disa glandulosa Burch.	11
Disa ferruginea (Thunb.) Sw.	11
Satyrium bracteatum (L.f.) Thunb.	10
Satyrium lupinulum Lindl.	9
Bartholina ethelae Bolus	8
Disa racemosa L.f.	7
Ommatodium volucris (L.f.) Lindl.	7
Disa cornuta (L.) Sw.	6
Acrolophia lamellata (Lindl.) Schltr. & Bolus	6
Satyrium carneum (Dry.) R. Br.	5
Disa cylindrica (Thunb.) Sw.	5
Schizodium sp.	5
Disa uniflora Berg.	3
Monadenia multiflora Sond.	3
Pterygodium acutifolium Lindl.	2
Satyrium bicallosum Thunb.	2

Species.	*No. of grid units containing at least one individual.*
Satyrium ochroleucum Bolus	2
Orthopenthea bivalvata (L.f.) Rolfe	1 (118 plants in 1955).
Monadenia reticulata (Bolus) Dur. & Sch. ..	1 (16)
Disperis bodkinii Bolus	1 (9)
Eulophia tabularis Bolus	1 (3)
Orthopenthea atricapilla (Harv.) Rolfe	1 (2)
Monadenia ophrydea Lindl.	1 (2)
Eulophia capensis (L.) Bolus	1 (2)
Ceratandra atrata (L.) Dur. & Sch.	1 (2)
Disperis paludosa Harv.	1 (1)
Forficaria graminifolia Lindl.	1 (1)

TABLE III.

Frequency of various densities of individuals.

Species.	Number of grid squares occupied at various density levels.					
	1—2 pl.	3—5 pl.	5—10 pl.	11—20 pl.	21—40 pl.	>40 pl.
Monadenia micrantha ..	27	3	3	—	—	—
Disa cornuta	5	1	—	—	—	—
Herschelia graminifolia	16	8	1	—	—	—
Disperis capensis ..	37	10	9	1	—	—
Disa ferruginea	6	4	1	—	—	—
Satyrium lupinulum ..	4	3	2	—	—	—
Satyrium bicorne ..	34	28	18	7	7	7
Satyrium coriifolium ..	4	2	4	2	1	—
Satyrium carneum ..	1	2	1	1	—	—
Holothrix squamulosa..	2	5	7	3	—	—
Liparis capensis ..	4	3	10	4	3	4
Satyrium saxicolum ..	—	4	2	6	6	5
Satyrium odorum ..	—	8	13	19	10	14
Pterygodium catholicum	—	2	6	5	8	24
Holothrix condensata ..	—	—	3	3	4	12

It can be seen from Table II that few species are widely dispersed. Species found in less than five of a possible 324 grid units comprise 34 per cent of the total. While two of the 42 species had not been found before in the area, a further 16 species recorded by previous collectors were not seen.

An unexpected characteristic of local dispersal is demonstrated by Table III. Several species widely scattered throughout the area were

often represented by only a few plants in each grid unit (e.g. *Herschelia graminifolia*, *Monadenia micrantha*). This type of distribution has been noted by collectors for *Disa cornuta*, which was not frequent enough in the area to illustrate this phenomenon clearly. Other species, notably *Satyrium odorum*, *Pterygodium catholicum* and *Holothrix condensata*, tend to be gregarious, whilst *Satyrium bicorne* and *Liparis capensis* are neither over- nor under-dispersed.

Aspect and Angle of Slope.

At an early stage in preliminary studies, the author noticed relative absence of many species on north-facing slopes. This led to an examination of the relationship between distribution and aspect.

The frequency of various species on different aspects is illustrated in Fig. 1. Lines radiating from the centre of each diagram show by their length the relative numbers of records of a species on various aspects. The frequency of slopes with such aspects is represented by an outline surrounding each diagram. Diagrams are presented for three classes of angle of slope.

Data for the diagrams was compiled from a 1 : 25,000 Trig. Survey Map of the Cape Peninsula. A grid with units representing 220 x 220 yards was laid over the map and in each unit the mean aspect and distance between contours was estimated. Each aspect value was listed in one of three tables, depending on whether the accompanying figure for distance between contours corresponded to an angle of slope class of 0°—10°, 10°—30°, or more than 30° from the horizontal. Within the angle of slope classes, the number of aspect values lying in each 20° sector of the compass was found and plotted on a radial chart. The resulting points were linked up to form the outlines of the diagrams, which thus show the approximate relative frequency of various aspects, within specified ranges of angle of slope. In the case of steeper slopes, no allowance was made for the fact that the surface area of a steep slope is diminished on its horizontal projection in a map.

A similar method was used to plot orchid localities, although field observations were used in places of great local variation in aspect. The number of plants in each slope class is shown next to the diagrams. With one exception, data is only presented for widely dispersed species. There was no exceptional behaviour among the less frequent species not represented in Fig. 1.

With the majority of species little response to aspect is shown on 0—10° slopes. Preference for south-facing slopes becomes apparent at 10°—30°, whilst in places steeper than this, many species are completely

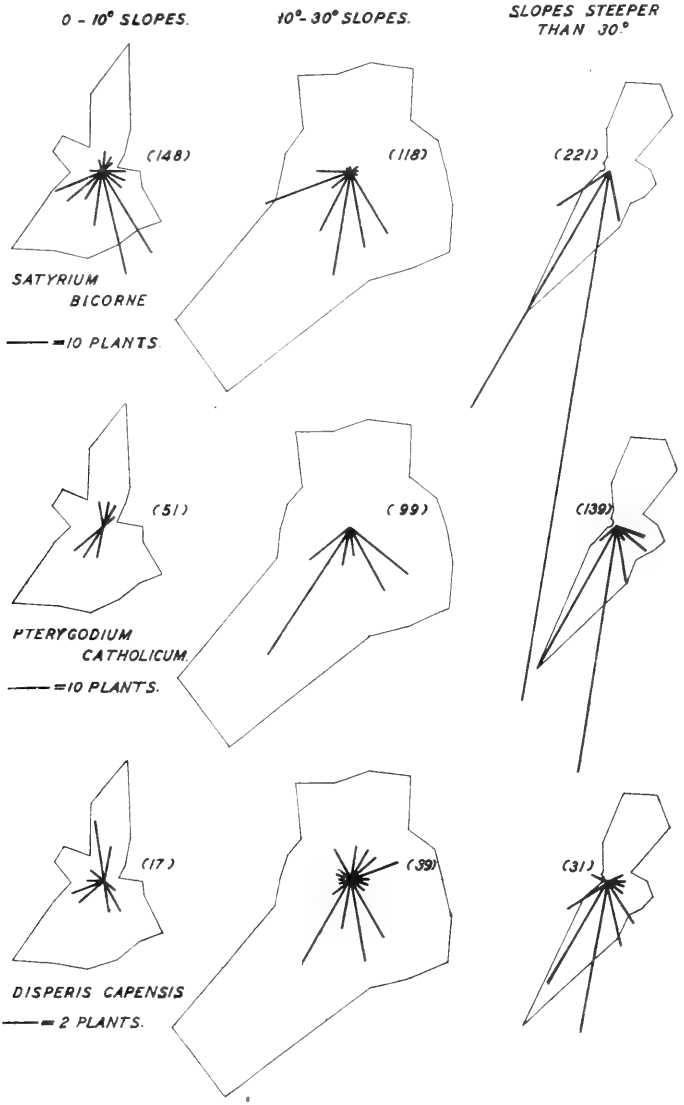


Fig. 1.—Diagrams to show the distribution of flowering individuals and colonies on various aspects and angles of slope. Aspects directly above the centre of each diagram face due north.
For further explanation, see text.

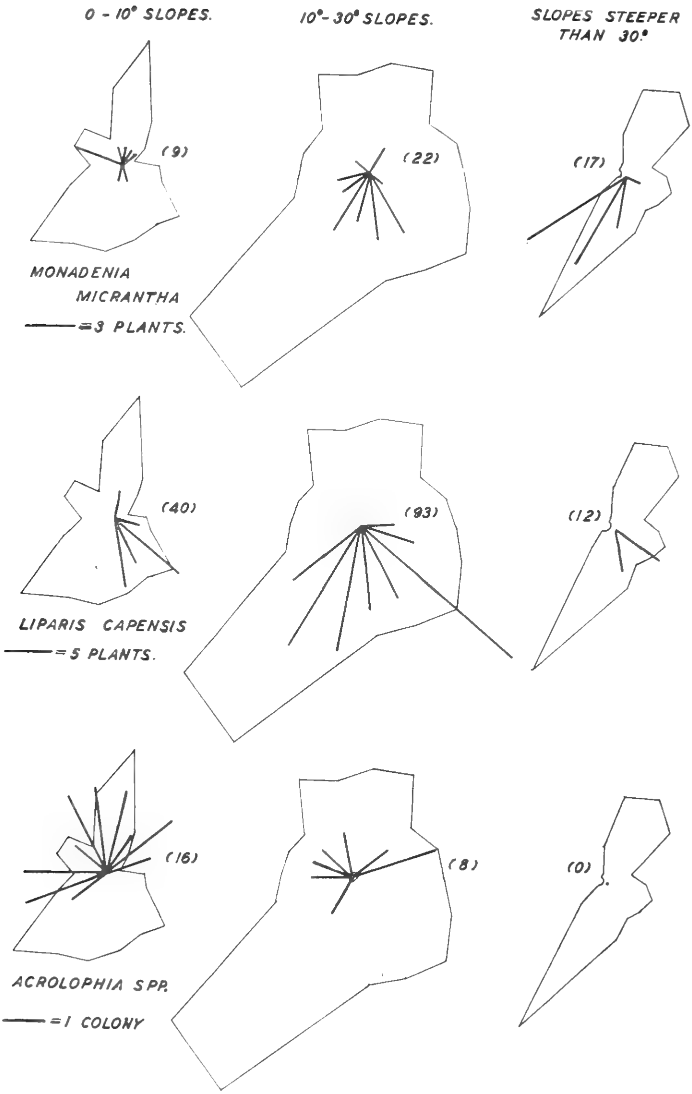


Fig. 1.—*Continued.*

excluded from slopes with the slightest north-facing aspect (e.g. *Satyrium bicorne*, *Pterygodium catholicum*, *Monadenia micrantha*). *Disperis capensis* shows greater ability to inhabit northerly aspects than the other species, especially on 10°—30° slopes. *Acrolophia spp.* appear indifferent to aspect on moderate slopes.

Altitudinal Range.

The altitudinal range of the most widely distributed species is shown in Fig. 2. Late summer-flowering species (*Disa ferruginea*, *Herschelia graminifolia*) and the early winter-flowering *Liparis capensis* are restricted to high elevations. In addition, species that inhabit moist ledges and crevices in cliffs (*Orthopenthea rosea*, *Disa maculata*) were not found in such places at low altitude.

Post-burning Period.

A number of authors have recorded increased activity of geophytes after fires (Adamson 1935, Michell 1922, Wicht 1949). This effect was noticed in preliminary surveys.

Accordingly, to obtain general information on immediate and long-term effects of fires, a map was prepared showing when each part of the area had been last burnt, for comparison with orchid distribution patterns.

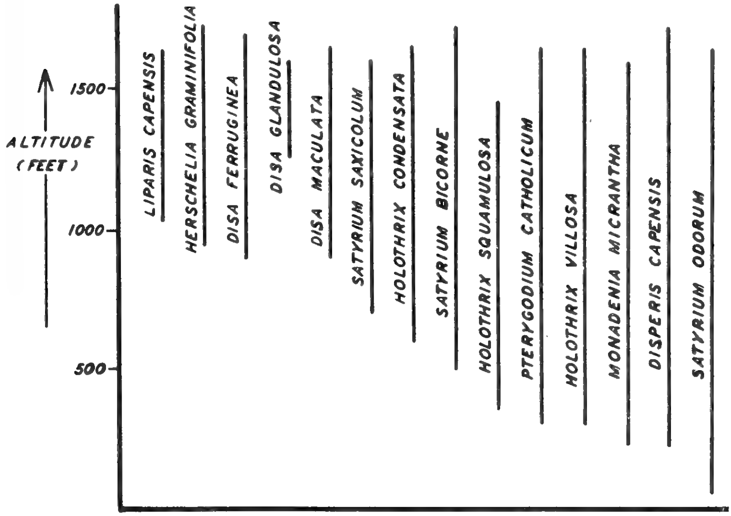


Fig. 2.—To show the altitudinal range of various species.

The approximate post-burning period was obtained by counting the number of annual zones of rapid growth on stems of certain shrubs. The zones were most clearly shown by members of the genus *Leucadendron* (Proteaceae), where they could be identified by lack of branching and wider spacing of leaf bases. The species used are destroyed by fire and regenerate from seed in the following spring. This method has proved reasonably reliable when tested on burnt areas of known age.

Frequencies of the more widespread species in veld of various ages are presented in Table IV.

TABLE IV.

Average number of plants or colonies in flower per square ¼ mile of veld of various ages.

Period since last fire occurred (years).	0—1	2—4	5—10	>10
Satyrium bicorne	80	7	8	3
Pterygodium catholicum	17	3	1	1
Monadenia micrantha	4	1	r*	r
Disperis capensis	—	r	r	1
Herschelia graminifolia	—	r	r	1
Satyrium odorum (colonies)	r	—	1	5

* r=rare.

While many other factors probably affect these results, frequencies in the first year after burning appear significantly high for the first three species. Results for the last three species showing lower frequencies in recently burnt areas may also be significant.

In addition to this more general method, detailed observations were made for five years on part of a burnt firebelt on the Muizenberg plateau. The firebelt consists of three adjacent 25-yard-wide strips of veld, each strip being burnt once every three or four years. Thirty-yard lengths of two such intermittently burnt strips were kept under observation, together with adjoining veld which had not been burnt for at least 10 years.

The stretch of firebelt studied passes from a dry sandy rise down into a zone which remains moist for the greater part of the year, being interlaced with streamlets in winter. Strip I of the firebelt was burnt in midwinter 1954, Strip II a year later. Strip I was burnt again in the autumn of 1958. Numbered stakes were used to indicate the positions of individual plants. Results are shown in Table V.

Monadenia micrantha and *Satyrium bicorne* did not show an excessive increase in numbers after fire, a result which is in contrast to data from other parts of the Muizenberg mountains (Table IV). *Orthopenthea bivalvata* and *Disa obtusa*, however, showed a very clear increase in numbers on both strips in the second season after burning. In the third season no trace of the plants could be found, and in the fourth season careful excavation of the staked sites did not reveal dormant tubers. Similar results were recorded for other species that appeared mostly on Strip I. As absence of aerial parts in the third season on Strip I coincided

TABLE V.

Numbers of flowering individuals occurring at various periods after fires in a small area on Muizenberg plateau.

Zone	Dry veld in Strips I and II					Moist veld in Strip I					Moist veld in Strip II					Unburnt veld
Approximate period since last fire, at time of flowering (years) ..						0·5	1·5	2·5	3·5	0·5	3·5	0·5	1·5	2·5	3·5	>10
Year in which flowering season began	1954	1955	1956	1957	1958	1954	1955	1956	1957	1958	1954	1955	1956	1957	1958	1954 1955 1956 1957 1958
Monadenia micrantha	1	2	2	–	–	1	2	3	3	–	–	–	–	–	–	All species absent.
Satyrium bicorne	1	1	1	–	–	–	–	–	–	–	–	3	3	2	3	
Orthopenthea bivalvata	–	–	–	–	–	–	115	–	–	–	–	3	12	–	–	
Disa obtusa	–	–	–	–	–	5	5	–	–	–	–	–	22	–	–	
Disa ophrydea	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	
Penthea patens	–	–	–	–	–	–	3	–	–	–	–	–	4	–	–	
Disa cornuta	–	–	–	–	–	–	2	–	–	–	–	–	1	–	–	
Eulophia tabularis	–	–	–	–	–	–	3	2	–	–	–	–	–	–	–	
Orthopenthea atricapilla	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	
Ceratandra atrata	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	

with the occurrence of large numbers of healthy plants of the same species on Strip II, it does not seem likely that the cycle could be a direct result of year-to-year variation of a factor such as rainfall.

Six of the 10 species recorded after the fire had not been encountered previously on the Muizenberg mountains. In contrast, no orchids were found in veld adjacent to Strip II that had been left unburnt for at least 10 years. Very few species were seen on the dry sandy rise in Strips I and II.

Soil Moisture.

Soils in the area studied were predominantly dry in summer, although certain places remained moist for the greater part of the year. The distinctive orchid flora found in these places is listed in Table VI.

Table VI.

Species restricted to moist habitats.

Moist flats.	Moist rock crevices and ledges.
Disa racemosa Orthopenthea bivalvata Orthopenthea atricapilla Disa obtusa Schizodium sp. Monadenia ophrydea Penthea patens Disperis paludosa Eulophia tabularis Ceratandra atrata	Disa uniflora Disa maculata Disa glandulosa Orthopenthea rosea Satyrium saxicolum

III. DISCUSSION AND CONCLUSIONS.

A notable characteristic of the orchid distribution patterns is the localization and rarity of a large percentage of the species. In many cases this rarity can be traced to the influence of factors such as fire and soil moisture, while for other rare species the relationship between distribution and ecological data is obscure.

An illustration of the connection between rarity and occurrence of special local conditions is provided by the sudden appearance, and subsequent total disappearance, of previously unrecorded species on the moist burnt stretch of firebelt discussed in the section on fire. This firebelt is situated on the Muizenberg plateau, where a number of similar moist places exist, that had not been burnt for periods of eight to about 20 years. If these places were swept by fire it seems possible that other species would come to light, among them some of those recorded from the area by previous collectors but not found there by the author.

A difficult feature of distribution to understand is the lack of local aggregation of certain widely dispersed species, notably *Monadenia micrantha*. This species almost invariably sets seed from all its flowers and does not appear to have unusual edaphic or climatic requirements. An investigation of seed fertility and germination may lead to an answer to this problem.

An interesting feature is the restriction to high altitude of late summer- and autumn-flowering species. The chief difference between low and high altitudes, apart from possibilities of rainfall variation, lies in the occurrence of damp mists in the dry summer months above about 800 feet. Similar results were recorded by Curtis (1947) in Haiti, where 150 of the 195 species of orchids found on the island were restricted to high elevations where mists were frequent.

The majority of species show a preference for south-facing slopes. North-facing slopes with greater insolation and correspondingly greater evapo-transpiration could be a less favourable habitat for herbaceous orchids. Two xeromorphic species of the genus *Acrolophia*, however, showed indifference to aspect on moderate slopes. Species with a marked response to aspect (*Pterygodium catholicum*, *Satyrium bicorne*) tend to show higher frequencies than other species on steep slopes. This is in contrast to the two *Acrolophia* species which were not found at all in very steep places. Somewhat intermediate behaviour is shown by *Disperis capensis* (Fig. 1).

Factors responsible for the sometimes rapid increase in numbers of flowering individuals after a fire are obscure, and critical experiments are needed for their elucidation. It is not yet clear whether the effect is due to stimulation of tubers present in a vegetative state at the time of fire, or whether burning provides particularly suitable conditions for germination of seed blown from elsewhere after the fire. In this connection, it is interesting to note that some species showed increased activity in the first (Table IV) and others in the second flowering season following a fire (Table V).

IV. SUMMARY.

1. Distribution patterns of 44 species of the family Orchidaceae were examined in a five-square-mile tract of mountains on the Cape Peninsula, South Africa.

2. A grid map was used in a systematic examination of the area, in which frequency and density of individuals of each species were recorded. A large percentage of the species were strongly localized in the area, in contrast to others that were widely dispersed but not frequent in any one locality.

3. Relationships between the distribution patterns and various ecological factors were examined as follows:

(*a*) Aspect and angle of slope data was presented in radial aspect diagrams. Herbaceous species showed a preference for south-

facing slopes, whilst two xeromorphic species showed indifference to aspect on moderate slopes. Species with a marked response to aspect showed higher frequencies on very steep south-facing slopes than elsewhere.

(*b*) A study of altitudinal range revealed that late summer-flowering species were restricted to high elevations. The possible correlation between this distribution and the occurrence of summer mists is discussed.

(*c*) An examination of post-burning periods in the area in relation to distribution revealed a marked increase in numbers of flowering individuals of certain species after fire. In addition, results are presented of five years of observations on a stretch of burnt firebelt and an adjacent unburnt area. The implications of these results are discussed.

(*d*) Species only found in certain moist habitats are enumerated.

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The author would like to thank Dr. E. A. Schelpe of the Botany Department, University of Cape Town, for his advice and most helpful criticism in the preparation of this work.

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A NEW ALOE FROM SOUTHERN RHODESIA.

By G. W. Reynolds.

(With Plates XXV and XXVI.)

Aloe hazeliana Reynolds. Species nova (Sect. Leptoaloe), affinis *A. inyangensis* Christian, caulibus erectis longioribus, foliorum vaginis 10—20 mm. longis, racemis laxioribus, bracteis et pedicellis et floribus brevioribus differt.

Planta habitus compactilis e sedibus caulibus paucis vel nonnullis. *Caules* graciles, erecti, usque 50 cm. longi, 15 mm. diam., summi 10—20 cm. laxe foliati. *Folia* disticha, c. 12, linearia, usque 20 cm. longa, 10—15 mm. lata, vaginis 10—20 mm. longis, copiose maculatis; *supra* planiuscula vel leviter canaliculata; *subtus* convexa, maculata; marginibus anguste hyalinis, dentibus albidis ·5 mm. longis, 5 mm. distantibus; foliorum apicibus obtuse cuspidatis minute dentatis. *Inflorescentia* simplex, 30—40 cm. longa. *Racemus* 8—10 cm. longus, 4 cm. diam., sublaxe c. 18-floribus. *Bracteae* ovato-acutae, 4 mm. longae, 3 mm. latae, obscure 3-nervatae. *Pedicelli* 13 mm. longi. *Perianthium* coccineum, 25 mm. longum, cylindrico-trigonum; *segmenta exteriora* libera, obscure 3-nervata. *Antherae* non vel brevissime exsertae. *Stigma* demum 1—2 mm. exserta. *Ovarium* pallide aurantiacum, 5 mm. longum, 2 mm. diametro.

Habitat: Southern Rhodesia, Melsetter District, Chimanimani Mountains: coll. Mrs. H. Munch, cult. Johannesburg, fl. 3 May 1959, Reynolds 9031 holotype (PRE); cult. "Mona" near Rusape, S. Rhodesia, fl. 5 May 1959, Munch 6/138! (K).

Our new species is named after Mrs. Hazel Munch who first collected plants in September 1945 on the Chimanimani Mountains about 20 miles south-east of Melsetter in Southern Rhodesia. Plants were found at altitudes from 5,000 ft. to 7,000 ft. on both sides of the Southern Rhodesia—Moçambique border, mostly in pockets of soil on rocks and in rock fissures.

A. hazeliana is a plant of compact growth with few to several slender erect stems from ground level; the stems average 30—45 cm. in length and are not branched above ground level. A striking character of *A. hazeliana* is that the apical 10—20 cm. of stems is laxly foliate, the leaves

always being distichous—alternately opposite if one might use the term. The sheaths are 10—20 mm. long, and are copiously white-spotted, while racemes vary from laxer to denser.

Its nearest ally is *A. inyangensis* Christian, which occurs further north in the Inyanga District and elsewhere, but has never been found on the detached Chimanimani range. *A. inyangensis* differs from *A. hazeliana* in forming considerably larger denser clumps that are sometimes a few feet across, and in having much shorter, thicker stems, leaves more densely crowded, longer bracts and pedicels, and flowers 40 mm. long.

DESCRIPTION: *Plant* of compact slender growth, with few to several unbranched stems from ground level.

Stems slender, erect, up to 50 cm. long, 15 mm. diam., with the apical 10—20 cm. rather laxly foliate.

Leaves about 12, distichous, linear, up to 20 cm. long, 10—15 mm. broad, suberect to spreading, straight or slightly curved, the basally sheathing portion 10—15 mm. long; *upper surface* flat to slightly canaliculate, unspotted or sometimes with a few small scattered pale green elliptical spots; *lower surface* green, rounded, with numerous crowded smaller pale green spots low down, the sheaths copiously spotted; *margins* with very narrow somewhat hyaline edge armed with firm white deltoid teeth about ·5 mm. long, and 5 mm. apart low down, smaller to obsolescent upwards, with the leaf apices obtuse, cuspidate, and minutely dentate.

Inflorescence simple, 30—40 cm. long, produced laterally.

Peduncle slender, basally flattened and 6—8 mm. broad, green, with a few broadly ovate-cuspidate sterile bracts.

Raceme laxly about 18-flowered, 8—10 cm. long, 4 cm. diam., the youngest buds greyish tipped and suberectly spreading, open flowers pendent.

Bracts ovate-acute, 4 mm. long, 3 mm. broad at base, slightly fleshy, obscurely 3-nerved.

Pedicels the lowest 13 mm. long, shorter upwards, the scarlet colour of the perianth.

Perianth scarlet, green-tipped, 25 mm. long, cylindric-trigonous, basally obtuse and shortly stipitate, 6 mm. diam. across the ovary, thence trigonous upwards; *outer segments* free to base, obscurely 3-nerved, the apices greenish, subacute, slightly spreading; *inner segments* broader than the outer, with broad pale marginal border and 3 crowded nerves forming a scarlet keel, the apices more obtuse and more spreading than the outer.

PLATE XXV. *Aloe hazeliana* Reynolds.
Plant × 1/4 approx. cult. Johannesburg.

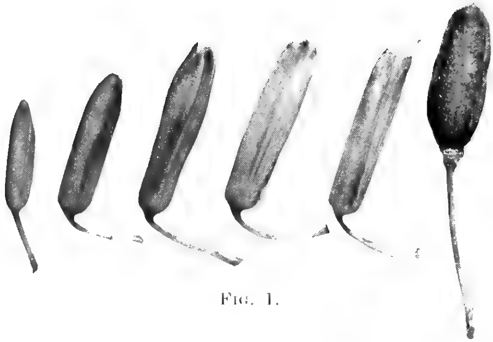

FIG. 1.

FIG. 2.

PLATE XXVI. *A. hazeliana* Reynolds.
FIG. 1.—Flowers 1/1, from bud to fruit stage.
FIG. 2.—Portion of a stem 1/1.

Filaments filiform-flattened, the 3 inner narrower and lengthening before the 3 outer with their *anthers* in turn not or exceedingly shortly exserted.

Stigma at length exserted 1—2 mm.

Ovary pale orange, 5 mm. long, 2 mm. diam.

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I am greatly indebted to:

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FRANCIS MASSON, A GARDENER-BOTANIST WHO COLLECTED AT THE CAPE.

By Mia C. Karsten.

(With Plates XXVII and XXVIII.)

III.

MASSON'S JOURNEYS AT THE CAPE (*Continued*).

On October 16, 1785, Masson again left for the Cape. He sailed from Portsmouth in the *Earl of Talbot* of the English East India Company and arrived in Table Bay on January 10, 1786. Prominent men on board, undoubtedly including Masson, immediately disembarked and took their lodgings with the widow of the former Burgher Councillor Petrus J. de Wit, who had a farm in the present Riversdale district.

However, on his arrival he soon met with difficulties when the authorities learnt about his intentions to proceed on journeys into the country, and it did not take him long to write the following letter to Banks[88]:

Cape of Good Hope,
Jany. 21, 1786.

Sir,

I have the pleasure to acquaint you of my arrival at this place on the tenth inst., after a passage of twelve weeks. Next day I waited on the Governor[89], and delivered the letter from the Dutch Embassador; he

[88] This letter and the one Masson wrote from the Cape on March 8, 1786, were published by Britten in his paper on Masson in the Journal of Botany, Vol. XXII 1884, pp. 119 and 120, from which they have been taken. There is little doubt that these two letters represent transcripts made by the daughters of Dawson Turner who was to have written a biography of Sir Joseph Banks. The transcripts are in the Botany Dept. of the British Museum (Natural History), but nothing is known about the whereabouts of the originals—if they still exist. Among the letters and accounts received from Masson in the Sir Joseph Banks Manuscripts Collection in the Sutro Branch of the California State Library (see below) there are none of the year 1786. The transcripts are supposed to be exact copies of the original letters, apart from having been cleansed of spelling mistakes. As a matter of fact we did not come across a single Masson original which did not show wrongly spelt words and (or) other errors.

Dawson Turner (1775-1858) was a botanist and antiquary. Maria, his eldest daughter, was married to Sir William Jackson Hooker, Director of Kew, known for his inaugurating the *Flora Capensis*.

[89] This is Lieutenant-Colonel Cornelis Jacob van de Graaff, appointed governor of the Cape in February, 1785. In June, 1791, he embarks for Europe, and never returns.

treated me in the most friendly hospitable manner, but was at a loss how to act respecting my request, as it was ordered by the Company that no stranger hereafter should have liberty to explore the country. However, the letter from the Embassador and the small distance from the Cape mentioned in my instructions, after lying it before the Council, he thought himself warranted to grant the request, which he did in the genteelest, friendly manner, advising me at the same time to conduct myself as not to excite the jealousy of the inhabitants, which was raised to a great degree on account of Mr. Patterson[90]. Mr. Brant[91] came up

---

[90] William Paterson (1755–1810), a traveller and soldier who was to become lieutenant-governor of Tasmania. He entered the army at an early age, but not before he had developed a strong liking for natural history, especially botany. Under the patronage of the eccentric Countess of Strathmore, he travelled widely at the Cape during the years 1777–79. He left England in February, 1777, arrived at Cape Town in May, and on October 16, in company with Capt. (later Col.) Gordon, made his first expedition into the interior, returning to Cape Town on January 13, 1778. His second journey lasted from May to November 20 of that year, while the third, from December 23, 1778, till March 23, 1779, was into the district which he called Caffraria, and, wrongly, claimed as hitherto unknown. We know that Thunberg has been there before, that this Swede made two journeys into Caffraria, during 1772–73 and 1773–74, described in his *Travels*. On June 18, 1779, Paterson set out on a fourth journey into the interior, together with Sebastiaan van Reenen; the party was later joined by Col. Gordon and Jacobus van Reenen. They returned to the Cape on December 21. These expeditions were described in his work *A Narrative of Four Journeys into the Country of the Hottentots and Caffraria in the Years* 1777–8–9. London, 1789. The work, which is illustrated, is dedicated to Sir Joseph Banks. A second edition and a French translation appeared in 1790.

Early in 1780, Paterson returned to England in a Dutch East Indiaman. He arrived in London on June 30, 1780. When England declared war on Holland on December 20 of that year, Paterson was transferred to Commodore Johnstone's fleet which left England with 3,000 men on board on May 13, 1781, in order to annex the Cape and to convoy the East India trade so far on the way. They attacked Saldanha Bay, where five Dutch East Indiamen were reported to be lying unprotected. Four of these were taken and towed off. After the attack the Indiamen, transports and several ships of the squadron under orders for the East Indies parted company. The rest with the prizes were sent home from St. Helena. Paterson too returned to England. In October of that year he was gazetted to the 98th Regiment, after which he was sent to India. In June, 1789, he was one of the lieutenants chosen to recruit and command a company of the newly-formed New South Wales Corps. He arrived in Botany Bay, N.S.W., in October, 1791. He was again in England in 1798, and was elected a Fellow of the Royal Society and the Royal Asiatic Society because of his contributions to science. In 1799 he returned to the Colony as lieutenant-colonel of the Corps. He was sent to Tasmania as lieutenant-governor in 1804, leaving that Colony in May, 1810. He died on the passage home on board her Majesty's ship *Dromedary* on June 21.

Lieut. Paterson made extensive collections of Cape plants for herbarium records, as may be judged from his account in *A Narrative*, etc. R. A. Dyer, in his paper *Col. R. J. Gordon's Contribution to S.A. Botany* (1949), says that Paterson's specimens have not been traced, which replaces the much older statement by C. A. Harris in *Dictionary of National Biography* (1895), from which most of above records have been taken, that his botanical collections are in the British Museum. The French traveller F. Le Vaillant speaks highly of Paterson's researches (*New Travels into the Interior Parts of Africa*, 1796), but in Thunberg's eyes he was not much of a botanist: "He professed to travel at the expence of certain individuals [the Countess of Strathmore!], and possessed some small knowledge of Botany, but was, in fact, a mere Gardener" (*Travels*, Vol. IV (1796), p. 271; see also this Journal, Vol. V, Oct., 1939, p. 153). Paterson is credited with having brought to England the first giraffe skin ever seen here.

from False Bay, and exerted his influence. Colonel Gordon[92] is in the back country, and is expected home in a month. I have collected about sixty sorts of seeds, which will be sent by Mr. Irvin, passenger in a Dane, who will touch at some port in the Channel. This I send by an Hanoverian officer, passenger in a french ship for L'orient.

Referring to the illustrations in *A Narrative*, etc., MUIR, in his article *'n Raaisel van die Agtiende Eeu* [A Riddle of the 18th Century], *I. William Paterson* (Die Huisgenoot, July 28, 1933, p. 15), writes (transl.): "Paterson's most remarkable talent was his great skill as a draughtsman and designer, not only of plants and animals, but also of landscapes and buildings—a gift which is of great value to a soldier". Regarding the pictures of Cape plants in PATERSON's work, see the chapter on MASSON's drawings.

[91] Mynheer CHRISTOFFEL BRAND, officer of the Dutch East India Company in charge of False Bay. He is also mentioned by SPARRMAN (this Journal, Vol. XXIII, April, 1957, p. 48), but the name is not correctly spelt. Moreover, BRAND being a Dutchman, his Christian name is CHRISTOFFEL and not Christopher.

[92] ROBERT JACOB GORDON (1741–95) was a son of Major-General JACOB GORDON, of the Scots Brigade, in the service of Holland. He was descended from a Scottish ancestor, who had emigrated to Holland much earlier. ROBERT JACOB was born with his father's regiment in Guelderland and was dedicated to an army career. He entered the University of Harderwijk in that province and, after leaving Harderwijk, he joined his father's regiment as a cadet. Being of an enterprising and scientific turn of mind, as DYER puts it, GORDON decided to travel.

He first touched at the Cape in 1773 for a short stay and returned there as a captain in the service of the Dutch East India Company. He was placed in charge of the garrison at the Cape, rose to the rank of colonel and died by his own hand in 1795.

When GORDON visited the Cape in 1773, he met THUNBERG and MASSON, and they went together on a little expedition, as related by THUNBERG in *Travels* (Vol. I, p. 265 (1795), the Cape 1773): "In the month of *May*, between the 13*th* and 19*th*, in company with Major GORDON and an English gardener, lately arrived, of the name of MASON, I made an excursion on foot round the mountains situate between the *Cape* and *False Bay*".

After he had returned to the Cape in 1777 as a "Kapitein Militair", GORDON proceeded on a long journey into the interior, accompanied by Lieut. PATERSON (cf. footnote 90) on October 16. They travelled along False Bay, journeyed to Swellendam, and stayed for five days at Rietvlei, a post of the Dutch East India Company. After having spent a short time on the farm of the VAN REENENS, GORDON and PATERSON journeyed together to the present Willowmore district. Then they parted company: PATERSON, who was not in good health, returned to the Cape, while GORDON continued the journey in a northern direction. Finally he reached the banks of a great river far inland, which he was going to name Orange River. This is the "Great River" of which rumours had reached the Cape from its first settlement. It was crossed by Capt. HENDRIK HOP and his party in 1761, but not named. The ceremonial christening of the river took place in August, 1779, when GORDON and PATERSON had joined forces again in an expedition to the region near the mouth of the river. This is described by PATERSON in his *Narrative of Four Journeys*, etc. (1789), and quoted by DYER in his paper *Col. R. J. Gordon's Contribution to S.A. Botany*, pp. 10 and 13 (1949): "In the evening we launched Colonel Gordon's boat, and hoisted the Dutch colours. Colonel Gordon proposed first to drink the State's health, and then that of the Prince of Orange and the Company; after which he gave the river the name of the Orange River in honour of the Prince".

PATERSON thought highly of GORDON, as stands out clearly from the following quotation from his book (DYER, *loc. cit.*, p. 9): "It was a circumstance peculiarly favourable to my views, that previous to proceeding on my journey [obviously his first expedition into the interior, 1777–78], I had the good fortune to meet with

I cannot express the obligation I am under to Sir Archibald Campbell[93] and all the gentlemen of the *E. Talbot*, who gave me assurance of a good reception in India, had I not succeeded at the Cape.

I thank you for the ready assistance you gave me at my departure. I shall remember the wine, but am sorry to inform you that it is raised from thirty Rix Dollars to eighty, and every other article in proportion.

I am, Sir,

Your most humble Servt.,

Frans. Masson

Owing to the obstacles thrown in his way which looked unsurmountable, MASSON felt so little at ease at the Cape that he wanted to leave the country altogether and be allowed to proceed to India, as we learn from the following extract from a letter of GEORG FORSTER to BANKS, dated January 30, 1786: "Mr. Masson will have written you that the Dutch Government permitted him to remain at the Cape; tho' it would seem that his Residence here is by no means generally approved of. They say that Mr. Patterson made an ill use of the Liberty that was given him, and an ungenerous return of the great kindness that was shewn him, in having accompanied Mr. Johnston[94] in the capacity of a

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a most intelligent companion, Captain Gordon (now Colonel), who had travelled in this country some years before, about 1774, and was lately returned from Holland as second in command, and appointed to succeed Colonel Du Phrem [Major (later Lt.-General) HENDRIK PREHN !], who was then Commander in Chief. Colonel Gordon is a gentleman of extensive information in most branches of natural history; and, I believe, is the only person who has any considerable knowledge of that country . . . " We may add to this that he had a command of the Dutch, English, German and French languages, and had also acquired a fair knowledge of some of the native tongues of the Cape. Moreover, he was a skilled draughtsman, and left a considerable collection of drawings, of the country, its inhabitants and its flora and fauna. More will be said about GORDON's work as a draughtsman in connection with the plates in MASSON's *Stapeliae Novae* (see the chapter on MASSON's drawings).

GORDON's loyalty to the Prince of Orange ended in tragedy. When Holland fell under the revolutionary government of France in 1795, the anti-Orange faction founded the Batavian Republic and the Stadtholder, Prince WILLIAM V, took refuge in England. Later in the year an English fleet arrived at Cape Town and demanded the surrender of the Colony to England on behalf of their ally. Col. GORDON, being in command of the military forces of the Dutch at Cape Town, found himself torn between the admiration he had always felt for the Prince of Orange and the loyalty he still felt to his country. He decided not to resist the English, but his honour as a soldier did not leave him any other way out than to shoot himself.

For most of the above records we are indebted to DYER in his paper on GORDON.

[93] Sir ARCHIBALD CAMPBELL (1739–91), of Inverneil, General and Governor of Jamaica and Madras. He entered the army as a captain in the Fraser Highlanders, served throughout the campaign in N. America (the Americans were revolting against the English). In July, 1782, he was appointed governor of Jamaica and in November of that year promoted major-general. In 1785 he was appointed governor and commander-in-chief of Madras. In the *Earl of Talbot* he was on the way to Madras.

[94] Commodore GEORGE JOHNSTONE (1730–87) commanded the expedition against the Cape of Good Hope in 1781. See footnote 90.

Guide. That such conduct was dishonourable, and wholly derogatory to the Character he was received in amongst them. Masson, whose worth and excellence there is no need of bearing Testimony of to you, is desirous of going to India, where at this time, Koning [KOENIG[95]] being dead, there is no person of his talents or Profession, and where, particularly in Bengal, there is an ample harvest of natural Curiosities to be reaped.

Could you therefore procure Masson's Mission to that Country, a benefit would be entailed on the State and Natural History, and a service rendered to an honest man."

FORSTER could not have been more appreciative indeed; MASSON was well thought of, both as a man and as a naturalist.

MASSON certainly had not anticipated that his second sojourn at the Cape would start with trouble. We may give a detailed account of what happened, and which will elucidate the foregoing[96].

On the day of his arrival, MASSON approached Governor VAN DE

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[95] This is JOHANNIS GERHARDUS KOENIG, born at Lemenen, Ungernhof, Govt. of Courland, Baltic, in 1728, and died at Jagrenathporum, India, in 1785. He studied pharmacy, biology, and medicine, and was a pupil of LINNAEUS for two years. In 1768 he went to India in the employ of the Danish (Moravian) Mission as a surgeon and naturalist at Tranquebar. In 1774 he entered the service of the Nabob of Arcot, and in July 1778 he was appointed naturalist at the Madras establishment of the Dutch East India Company, to which he was attached for the rest of his life. He bequeathed his manuscripts and plants to Sir JOSEPH BANKS; they are now in the British Museum (Natural History).

For the above records we are indebted to Mrs. M. J. VAN STEENIS-KRUSEMAN; they have been taken from her work *Flora Malesiana* I, 1, 1950, pp. 288–89 (first general part under the sub-title *Malaysian Plant Collectors and Collections being a Cyclopaedia of Botanical Exploration in Malaysia . . . up to the year* 1950), publ. in Holland. It may be added that KOENIG is among the botanists and collectors of whom short biographical data are given in the preface to THUNBERG's *Flora Capensis.* THUNBERG says about him (edit. Schultes, 1823, Praefatio Auctoris, p. VIII): "KOENIG, Danus, sub itinere suo in Malabariam, brevi in Promontorio bonae spei commoratus, indefessâ opera plantas plures legit, quas cum illustr. LINNAEO communicavit, quaeque in Mantissis describuntur". [Transl.: KOENIG, a Dane (!), having remained a short time at the Cape of Good Hope, on his journey to Malabar, collected with tireless energy many plants which he sent to the illustrious LINNAEUS, and which are described in his Mantissae (=*Mantissa Plantarum*, 2 vols., 1767 and 1771). In his paper on the younger LINNAEUS's letters to ABR. BÄCK 1778, in Svenska Linné-Sållskapets Årsskrift (Årgang XXXVII–XXXVIII, 1954–55, p. 140, footnote 6), A. HJ. UGGLA refers to KOENIG as having sent large collections of plants to LINNAEUS.

SPARRMAN in his letter of May 2, 1772 (see this Journal, Vol XXIII, Oct., 1957, p. 130), writes that he has forwarded LINNAEUS's letter to KONIG in Tranquebar. We had not any records of him at the time, and in footnote 63 he was wrongly assumed to be a merchant and perhaps a representative of the Swedish E. I. Company. This personality is not to be confused with CHARLES DIETRICH EBERHARD KONIG (orig. KÖNIG), German-born naturalist and assistant to DRYANDER (see Part I of our paper, this Journal, Oct., 1958, p. 210, footnote 17).

[96] J. MUIR, *'n Raaisel van die Agtiende Eeu* [A Riddle of the 18th Century], I. *William Paterson,* Die Huisgenoot, July 28, 1933, pp. 59 and 61; II. *Francis Masson,* ibid., Aug. 4, 1933, pp. 17 and 69. V. S. FORBES, *Paterson's Travels,* S.A. Geogr. Journ., Vol. XXX, April, 1948, pp. 52–70. D. DUCKWORTH, *The Log-book of William Paterson,* Africana Notes and News, Vol. 12, June, 1957, pp. 194–5.

GRAAFF and the Council of Policy ("Politieke Raad") for permission to collect plants. He handed his credentials and a letter of introduction to the Governor, which were directly addressed to this gentleman through the agency of the Dutch Ambassador in London, D. W. VAN LIJNDEN, at the urgent request of the Marquis of CARMARTHEN, Minister of Foreign Affairs. It was most unfortunate that the letters had not come by the agency of the Directors of the Dutch East India Company, in Holland, neither from the Dutch Government. Holland had been at war with England from 1780–83, but the fear of espionage, stiffened by Lt. PATERSON's behaviour, had continued at the Cape. MASSON's request, with which the authorities in Holland had nothing to do, put the gentlemen at the Cape in a rather awkward position. It is beyond doubt that when PATERSON was sent with Commodore JOHNSTONE's fleet to the Cape (see footnote 90), this was on account of his being acquainted with the coastal regions which he had visited during his stay at the Cape (1777–80), so he could act as a pilot into Saldanha Bay. We do not know if PATERSON willingly or unwillingly participated in the expedition against the Cape. As a soldier he had to obey, but had he deliberately collected information of military value when he was exploring the coasts in anticipation of a war with Holland? If this is the case, he has very badly repaid his former friends at the Cape for all hospitality and help bestowed on him. PATERSON might have known when the outbreak of war was to be expected. He left the Cape rather hurriedly early in 1780, after having nearly landed in jail because of debt. His patron, the Countess of STRATHMORE, having refused to cover all his further expenses—she simply ignored him—the commander of the troops at the Cape, Lt.-General PREHN[97], helped him out by advancing him some money. In any case PATERSON's behaviour was greatly taken amiss at the Cape.

Returning to MASSON, he definitely was a better man than PATERSON and has achieved far more in the field of natural history. We can only regret that the events placed him in a doubtful position. However, the suspicion was gradually waning, and MASSON would not return to England until 1795.

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[97] HENDRIK PREHN, of German extraction, was born at the Cape in 1733. He was sent to Holland in 1752, and saw military service in the Seven Years' War in Germany. He returned to the Cape in 1768 as a major and was promoted to the rank of lt.-general in 1779. In the following year he returned to Holland, where he died in 1785.

He is introduced by SPARRMAN in Vol. I of his *Voyage* as "Baron van Prehm" (see this Journal, Vol. XXIII, April, 1957, pp. 46 and 47). According to E. MORITZ (*Die Deutschen am Kap unter der Holländischen Herrschaft*, 1652–1806, publ. 1938), there is no evidence that HENDRIK PREHN (not Preh*m*) was ever made a baron and entitled to have his name preceded by a "von" as a reward for his military services in Germany.

In one of the letters from the Dutch Ambassador addressed to the Governor, it is said that MASSON "had been dispatched by the King of England to collect for his Majesty's Gardens [the Royal Gardens at Kew] the noteworthy herbs and plants growing at the Cape of Good Hope". The letters were submitted to the Council of Policy, and from the Resolution[98], which was passed forthwith, the following may be quoted here.

"That on account of the advantage that could be taken of such a permission, like the example given, viz. by the English Botanist Paterson, who, having obtained a liberty of the kind, has acquired by that such a knowledge in this matter, that afterwards he was, as one will understand, commissioned to the fleet of Commodore Johnstone, in order to be of service, in case one would have consented to attempt the landing at this place [Saldanha Bay]; therefore his Honour [the Governor] would not have had any objections to refuse that request forthwith. . . . Wherefore, in view of the aforesaid well-founded statement, supplied by the Governor, it was considered that the request as it stands of the above-mentioned Botanist Mason to this Council could not be complied with, but that on the other hand the representations made by his Excellency the Ambassador in the above-mentioned letter, should be fully deferred to. Therefore it has been agreed to comply with the above-mentioned request. But thereby this same Botanist Mason, concerning his making of journeys in this country; the restrictions are that all opportunities are to be denied to him to approach the sea-coasts within a distance of three

[98] Resolutions of the Council of Policy, dated the 17th January, 1786, in the Government Archives, Cape Town. The original Dutch text reads as follows: "Dat uit hoofde van het verkeerd gebruik, het welk van diergelijke permissie zoude kunnen werden gemaakt gelyk een voorbeeld daarvan gegeven is, door den Engelschen Botanicus Paterson, die eene vrijheijd van dien aard bekomen hebbende, daar door eene zodanige kennisse de deeessen [sic] heeft bekomen, dat hij naderhand, gelijk men verstendigt is, op de vloot onder den Commandeur Johnstone is geplaatst geworden, om in cas men zoude hebben kunnen goedvinden de landing tegens deese plaatse te onderneemen, daartoe van dienst te zijn, sijn Edele dierhalven geene bedenkingen zoude hebben gehad, dat versoek direct van de hand te weysen. . . . En nadien om de voors[eide] door den Heeren Gouverneur Bijgebragte allezints gegronden remarque wierd geoordeeld, dat in het bloot versoek van voorm[elde] Botanicus Mason bij deesen Raade mede niet zoude kunnen werden getreeden, dog dat men aan de andere zijde zig niet heeft kunnen onthouden aan de betuijgingen, door zijn Excellentie den heere Ambassadeur bij de voorwz. brief gedaan, volkomen te defereeren, is mitsdien verstaan, het meergem. versoek t'accordeeren, dog daarbij aan denzelven Botanicus Mason omtrent zijne reijsen in het land te maken, die bepalingen dat hem alle geleegenheden werden afgesneden, om op den afstand van drie uuren gaans de zeekusten te naderen, en denzelven tot het opspeuren en verzamelen der merkwaardigen kruijden en planten overvloedige ruimte te laten op alle oorden en Bergen die binnen de bepalingen geleegen zijn, mits ook die Bergen binnen gezegde uijtersten slegts aan de Landseijde beneden langs te mogen besoeken en doorkruijsen". If MASSON should trespass, the orders were „om hem dadelik te arresteeren en ter naaste plaats in verseekering te brengen".

hours' journeying; and to allow to the same abundant scope for searching for and collecting notable herbs and plants on all regions and mountains that lie within the defined limits; provided that also the mountains within the said extreme limits may only be visited and traversed along their lower landward slopes." In the event of any trespassing by MASSON, every inhabitant was empowered and ordered to arrest him, viz. "immediately to arrest him and take him into custody at the nearest place". Then he would be brought back to the Cape at his own expense, and permission (to travel again) would be withdrawn.

So he got the permission, but with certain restrictions keeping him from the coast, which was contrary to the instructions given him by BANKS, who wanted his collecting activities limited particularly to the shores of False and Hout Bays, as we shall see in BANKS's letter to MASSON of June 3, 1787.

After all, in spite of the difficulties he met with, MASSON abandoned the India plan and decided to remain at the Cape. He settled down to work and sent the following letter to BANKS:

Cape of Good Hope,
8th March, 1786.

Sir,

About the 8 or 9 of last month I wrote you per favour of *Mr. Irwin*, passenger on board a Danish Indiaman, who was also good enough to take charge of a parcel of seeds of about one Hundred and two species, which I hope you will receive in season to sow. Since that date I obtained permission of the Governor to visit Hottentot Holland mountains for only five days, and was so fortunate to find some of the rarest *Eruae* [*Ericae* !] and *Proteae* in seed. I also found some new species of *Proteae*, which is not yet described, and some other Genera, which now convinces me that these mountains, although so near the Cape, has never been properly explored. There is seed of an *Erica* which I have named *E. Banksiana*, of which you have but an imperfect specimen in your collection. It associates with *E. Plukenetii* and *E. Petiverii* in figure of the Corolla. As all the seeds are in their Capsulas, some are so minute that great attention must be had to rubbing them out when they are sown, otherwise many will be lost. *E. retorta*, *coronaria*, *pinastra*, *Massonii*, grows on the mountains in white sand produced from the sandstone rocks which compose the mountains, and in England will require a Turf soil mixt with a little sharp white sand[99].

[99] The various *Erica* spp. mentioned here: Erica Banksiana=*E. banksia*, Andr. var. *purpurea*, Andr.; *E. plukeneti*, L.; *E. petiveri*, L.; *E. retorta*, Montin; E. "coronaria": MASSON obviously meant E. coronata, Andr., later renamed *E. fascicularis*, L. f.; E. "pinastra"=*E. pinea*, Thunb.; *E. massoni*, L. f.

We have three English Ships of War here, who will remain for some weeks, and will not arrive in England untill late in Summer. I therefore send part of my collection by Sir Thomas Milne, who is passenger in a Portuguese Ship bound to Lisbon. The parcel contains 117 species; a Catalogue of both parcels is enclosed.

I am, Sir,
Your most obedient
humble Servant,
Frans. Masson

This is the last letter written by MASSON in 1786 in the Banksian correspondence.

MASSON's genuine interest in the vegetation of the country and his zeal as a plant collector made him disobey BANKS's instructions and go on collecting expeditions much farther afield, which was not heartily approved of at home, as appears from the following quotations from a letter addressed to him by BANKS, dated June 3, 1787:

"Mr. Masson,

The Plants you have sent home have succeeded so much better than any you sent home when you was last at the Cape that we have every reason to praise your industry, & to see the propriety of a search near the place of your residence in preference to expensive journeys up the country, which seldom produce an adequate return in really ripe seeds.

I hope that before this time you have taken up your head-quarters as I directed at False bay; the most rare plants to be met with in European herbariums are from that place, & you know that one rare described Plant is worth two nondescripts.

I intended about this time to have asked leave of his Majesty to order you to Botany Bay; but, finding from your letter to Mr. Aiton that you had an aversion to the place, I have made interest that another person should be sent there."

In a postscript he mentions having received letters from MASSON while writing the above, and adds:—

"These letters mention your having undertaken 2 long Journeys, which surprised me, as your instructions are very absolute on that subject. What I recommend is a fixed residence during the ripening season at any place where plants are abundant; but more especially that my directions relative to False Bay be complied with; & till you have exhausted that place and Hart [Hout !] Bay, which I expect will be prov'd rich, I trust you will remain quiet; afterwards you may propose excursions."

So far BANKS. The above quotations contain a rather curious remark, viz. about not yet described plants, and we wholeheartedly agree with MACOWAN, who writes[100]: "Botanists now-a-days are not of Sir JOSEPH BANKS's opinion. With them the non-descripts are precisely the objects of special search, and a botanical collector who should contentedly become a fixture on the shores of False Bay, would speedily hear from his employers something to his disadvantage."

Why did Sir JOSEPH want to restrict MASSON's collecting activities to these coastal regions? Was there some other reason which had nothing to do with botany? Some of the most important forts were at Hout Bay and along the coast of False Bay, the very places BANKS wanted MASSON to explore thoroughly. Moreover, BANKS's statement that the rarest plants to be found in herbariums in Europe have come from that place, is rather strange and open for more than one explanation. As we have seen, MASSON was not at all keen to stick to the shores of False Bay, etc. (where his movements were restricted by the Cape Government !), which made him explore the interior against BANKS's instructions. This certainly speaks in his favour, if there should be any suspicion of espionage. His account of his journeys clearly shows how he was fascinated by the flora and fauna of the country he traversed. When he left the Cape in March, 1795, he undoubtedly knew when the outbreak of war could be expected. It was only a few months later, on June 11, that Admiral ELPHINSTONE landed his army at False Bay. We think this need not necessarily place MASSON in an unfavourable light. In his *Stapeliae Novae* he says, as we shall see later, that fear to lose his plants in an expected invasion, prompted him to leave the country. MUIR[101] seems to be a little suspicious about this, but in our opinion the reason given by MASSON is quite acceptable, for he certainly had in mind that owing to the war with France part of the collected material sent home from the West Indian Islands never reached their destination (see BANKS's Memorandum !).

Finally, it should be put forward that when MASSON arrived at the Cape in January, 1786, the plans for the defence of the Colony were already known to Lt.-Col. WILLIAM DALRYMPLE, consequently also to the British Government.

But what about Sir JOSEPH BANKS? His behaviour definitely gives much more rise to suspicion than MASSON's. MUIR even goes so far as to introduce him as "a master-intriguer, apparently busy trying to lead up the garden path the Dutch East India Company and Governor van de

[100] MACOWAN, *Personalia of Botan. Collectors at the Cape*, republ. by VERDUYN DEN BOER in Botanists at the Cape I, p. 42 (1929).

[101] J. MUIR, Die Huisgenoot, Aug. 4, 1933, p. 69.

Graaff" (transl.)[102]. However, BANKS, one of the most prominent botanists of that period, is also mentioned as not wanting to be mixed up in politics.

Miss EDWARDS, Librarian of the Botanical Department of the British Museum (Natural History), gave us some information as to the whereabouts of originals in MASSON's handwriting, letters and other items MASSON sent to BANKS during and after his second stay at the Cape. We obtained photographs of these autographs, hitherto unpublished. There are three short letters, a note regarding his *Stapeliae Novae*, and six expenses accounts, the latter including two duplicates.

The first item to be published here is an account in the custody of the Royal Botanic Gardens, Kew[103]. The authorities at Kew were not quite certain if the document is in MASSON's own hand. But comparing this item with the other accounts we laid hands on, we find the handwriting completely identical. We have thoroughly examined the handwriting of the various letters and accounts, and there is no doubt about it that it is all MASSON's.

The account, slightly damaged or faded in places, reads as follows:

EXPENCES AT THE CAPE OF GOOD HOPE ON ACCOUNT OF HIS BRITANNIC MAJESTY, FROM THE FIRST OF MARCH 1788 TO THE FIRST OF JAN^{y} 1789 PRELUDING A JOURNEY TO THE ELEPHANTS RIVER BEING ABOUT 200 MILES DIST FROM THE CAPE

To two Journies to False Bay	20 – 6
To Boat hire on various occasions	14 – 7
To Cooley hire on various occasions	22 – 1
To Garden Pots & Boxes	75 – 7
To Stationary Ware	22
To a large Chest	12
To Baskets	7 – –
To a large Carr	220
To 10 Oxen a 12 R.D^{s} each	120
To a Dutch Waggoner & Hottentot for 5 months a 15 R.D^{s} p^{r} month	75
To Powder & Shot	12 – 6
To Cooking Utensils	20 7
To various necessaries for the Journey	45 6
To 10 Months Board & lodging	400
	1069 –

[102] J. MUIR, *loc. cit.*, p. 17.
[103] BANKS Correspondence, Vol. 1, folio 332.

The entries are in old Cape currency, viz. Rijksdaalders, Rixdollars (R.Ds.), and schellingen. The schelling was a silver coin to the value of 6 stuivers (about sixpence, thus 2 schellingen to a shilling). There are 8 schellingen, or 48 stuivers, to a Rijksdaalder. In THUNBERG's *Travels* (Vol. I (1795), p. 231), it is erroneously stated that a Rixdollar is valued at eight "shillings".

The expenses preluding a contemplated journey to the Olifants River ("Elephants" R.), amount to 493 Rixdollars and 3 schellingen (six entries, from "To a large Carr"). Next account shows that this journey was extended as far as the Kamiesberg in Namaqualand, for which they had to cross the Olifants River and proceed in a northern direction. This made the expenditure much higher. We wonder whether so much money spent on a single journey met with the full approval of BANKS. This journey is also referred to in two of MASSON's letters to THUNBERG (see below).

A number of MASSON originals have found their way to the Sutro Branch of the California State Library, San Francisco, as part of the BANKS Manuscripts Collection. There are a total of three letters and three accounts, the latter with two duplicates, which may be introduced here in chronological order.

1. EXPENCES AT THE CAPE OF GOOD HOPE ON ACCOUNT OF HIS MAJESTY FROM THE FIRST OF JANry 1789 TO THE FIRST OF JANry 1790. INCLUDING A JOURNEY TO THE CAMIES BERG BEING ABOUT 400 MILES DISTANT FROM THE CAPE.

Janry	To A Journey to French Hook for 14 days – – – – – – –	12	
April	To a Journey to Hottentots Holland. 14 days – – – – – – –	12	
	To Cooley Hire – – – – – – – – – – – – – – – – – – –	28	
	To Boat Hire – – – – – – – – – – – – – – – – – – –	10	
	To Baskets –	12	
May	To a Journey to False Bay for 8 days – – – – – – – – –	10	
	To Stationary Ware – – – – – – – – – – – – – – – – – –	30	5
	To a person in the course of 3 years for watering the Plants in my absence. – – – – – – – – – – – – – – – – – – –	18	6
	To Boxes for living Plants, Bulbs, Seeds &c – – – – – – – –	59	7
	To a Spade & Watering Pot. – – – – – – – – – – – – – –	5	
	*To 3 oxen – – – – – – – – – – – – – – – – – – –	40	
	To a Musquet – – – – – – – – – – – – – – – – – –	40	
	To 2 Hottentot Waggoners for 5 months a 10 Rix Doll. pr month. –	50	
	To Powder & Shot – – – – – – – – – – – – – – – – –	16	
	To Leather Canvas & cours linnen for Seed bags – – – – – –	12	6
	To keeping my oxen for 7 months a 5 RD p month – – – –	35	
	To Do for my Horse – – – – – – – – – – – – – – – –	75	
	To Necessaries on the Journey – – – – – – – – – – – –	100	
	To mending the Carr on the Journey – – – – – – – – – –	10	
	To Board & lodging for 9 months – – – – – – – – – – –	360	
		937	– –

Expences at the Cape of Good Hope on account of his Majesty from the first of Janry 1789 to the first of Janry 1790. Including a Journey to the Camies Berg being about 400 miles distant from the Cape.

Massons Expenses from Jan 1 1789 to Jan 1st 1790

Janry	To A Journey to French Hook for 14 days	12	
April	To a Journey to Hottentots Holland. 14 days	12	
	To Cooley Hire	28	
	To Boat Hire	10	
	To Baskets	12	
May	To a Journey to False Bay for 8 days	10	
	To Stationary Ware	30	5
	To a person in the course of 3 years for watering the Plants in my absence.	18	6
	To Boxes for living Plants, Bulbs, Seeds &c	59	7
	To a Spade & Watering Pot.	5	
	*To 3 Oxen	40	
	To a Musquet	40	
	To 2 Hottentot Waggoners for 5 months at 10 Rix Doll. pr month	50	
	To Powder & Shot	16	
	To Leather Canvas & cours Linnen for Seed bags	12	6
	To keeping my oxen for 7 months at 5 RD pr Month	35	
	To Do. for my Horse	75	
	To Necessaries on the Journey	100	
	To mending the Carr on the Journey	10	
	To Board & lodging for 9 Months	360	
		937	

Plate XXVII.

Expenses Account Jan. 1, 1789 Jan. 1, 1790, Masson sent to Sir Joseph Banks from the Cape.
Banks Manuscripts Collection, Sutro Branch, California State Library, San Francisco.

There is a marginal note in a scribbly handwriting, presumably BANKS's, which reads: "Masson's Expences from Jan 1st 1789 to Jan 1st 1790". The account is reproduced herewith (Plate XXVII).

From the entry marked by MASSON with an asterisk, all expenses—apart from the amount entered for board and lodging—are obviously connected with the journey to the Kamiesberg. From this account and also from MASSON's letter to THUNBERG of March 21, 1793, it is not clear when the journey was undertaken, but from notes in MASSON's own hand on the face of two of his botanical drawings, Nos. 133 and 116, at the British Museum[104], it is evident that it was in 1790. MASSON is not responsible for all information appearing on his drawings. He gives the name of the plant, unless he failed to identify it, and describes the locality, at the same time stating when the plant was collected. In addition to this he often gives some botanical characteristics. Most of these notes are in faulty Latin. On some drawings he has written down one or two remarks about the colouring of the picture. Apart from the notes in MASSON's own hand, all but one of the transcripts we received of the notes on ten of his drawings, show some additional notes, written down by (a) later botanist(s), when checking on the identity of the pictured plants. We may now quote the information given on the two drawings referred to (notes in a later hand printed in italics).

No. 133. "Gethylis verticillata R. Br. in locis arenosis ultra Piquetberg. Hort. Masson 1790. Natural size." (Transl.: . . . in sandy places beyond Piquetberg . . .). This plant of the Amaryllis family is still known as *Gethyllis verticillata*, R. Br., and was later found near Vredendal in the Van Rhynsdorp Division.

No. 116. "Amaryllis radula. Coroll. a little brighter anthers darker. F. in Hort. Mass. Loc. nat. in coleibus aridissimus. Karo prop. Elephants River. Cap. B.S. 1790." (Transl.: . . . Flowered in Masson's Garden. Natural habitat on very dry hills. Karroo near Olifants River . . .). Written beneath in a later hand: "*See Baker. Amaryllis* 98. *Brunsvigia radula Ait.*" The reference is to J. G. BAKER's *Handbook of the Amaryllideae* (1888). *B. radula*, Ait., a valid species, was found by H. HALL in two places in Namaqualand, Wallekraal and Steinkopf, in 1954 and 1956 respectively.

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[104] In his thesis *The Expanding Horizon* (1957) FORBES, who has seen MASSON's botanical drawings in the British Museum (Natural History), refers to the information *re* the time MASSON's journeys were undertaken, provided by notes on his drawings. This made us approach the Librarian of the Botany Dept., Miss EDWARDS who kindly presented us with full transcripts of the notes on the various drawings referred to—ten in all. Apart from these, we received from her transcripts of the notes on several other drawings.

Unfortunately, no months are stated, but it is possible that MASSON was outward bound when he collected those plants.

The garden referred to is MASSON's famous "little garden" at Cape Town (see below).

2. Cape of Good Hope 29 June 1792

Sir

Inclosed I send you my annual expences for the years 1790 and 1791. The articles are as nearly posted as nearly as possible consideing my wandering Stat of living. and you may rest satisfied that every penney has been employed for the good of the Service.

I had given up thoughts of making more long Journies but having a Waggon. I think 4 or 5 months in some of the most unfrequented parts (by Botanist) of the country would be more interesting than remaining about the Cape. in which case I must buy a Set of oxen my others was very old. and Several of them destroyed by the Hyaenas. I therefore sold the remaining 8 for 64 Rix dollar to the Butchers.

My intention of setting out in the month of August has obliged me to draw money for the current year much sooner than usual the bill is of 1000 Rix dollar

Our India Ships homeward bound not touching here this season prevented me from sending the accounts sooner

I am Sir most respectfully
your Frans Masson

Sir Joseph Banks

The journey he was preparing definitely was the one to the Klein Roggeveld (150 miles in direct line from the Cape), mentioned in his letter to THUNBERG of March 21, 1793. He must have left the Cape early in August, according to a note on No. 115 of his drawings of Cape plants, informing us that the pictured plant, *Massonia latebrosa*, Mass., was found in August, 1792, in the Bokkeveld, which is on the road to the Klein Roggeveld. From the information given, the sketch appears to have been made by MASSON of the collected plant when it flowered in his garden at Cape Town. The information on the face of the drawing reads as follows: "Massonia latibrosa. Hab. in spelunca Bokefeld Fl. in Hort. Anthers & stam, much finer. C.B.S. August, 1792." (Transl.: . . . Habitat in a cavern in the Bokkeveld. Flowered in Garden . . . .) This is followed by a note in a later hand, viz. "*Massonia latebrosa*

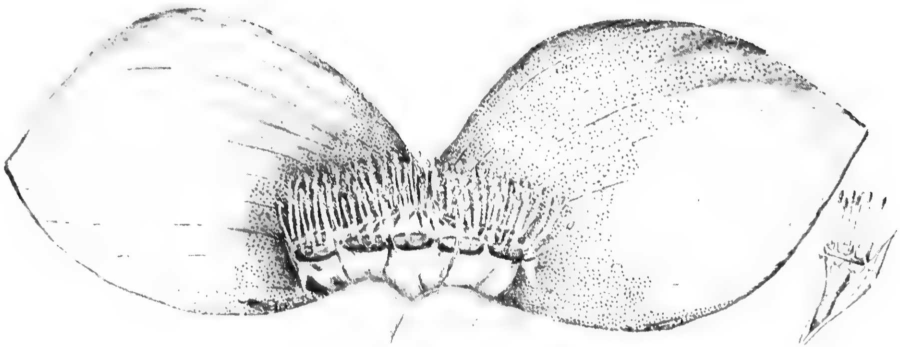

Plate XXVIII.

Masson's drawing No. 113, "Massonia scabra", identified as *Massonia pustulata*, Jacq. The notes in Masson's hand on the drawing are very faint, are hardly discernable.

By permission of the British Museum (Natural History)

Masson! Journ. Bot. 1886, 336." The article referred to in the Journ. of Bot. (British) is on new Cape Liliaceae, contributed by BAKER. *M. latebrosa* is an undetermined species, it has never been rediscovered. The description in BAKER's paper and in the *Flora Capensis* is from MASSON's drawing. The habitat as given by MASSON sounds a bit strange. But Miss BARKER writes that she has seen Massonias growing at the base of overhanging rocks, which could pass as caverns. The name MASSON has given to this "mystery species" is very appropriate, as it refers to its way of growing: "latebrosa" means hidden. Finally, it should be mentioned that this drawing is inscribed "F. Masson pinxt."

Among MASSON's drawings there is a picture of another *Massonia* species, named in his hand "Massonia scabra". This is drawing No. 113, reproduced herewith (Plate XXVIII). MASSON's notes on the face are as follows: "C.B.S. 1792—In hort Massoniana in Junius." A later hand identifies this plant as *Massonia pustulata*, Jacq., and gives as reference *Fl. Cap.* VI, 411. As mentioned in this work, *M. pustulata* (syn. M. scabra, Andr.) was introduced into cultivation by MASSON in 1790. But there is no record when and where it was found by him. Miss BARKER drew our attention to a picture of this species, made by Miss B. O. CARTER, and published in the *Flowering Plants of South Africa*, as Plate 915 (Vol. XXIII, 1943), with the description and notes by Miss F. M. LEIGHTON. The specimen illustrated came from Cape Infanta in the Swellendam Division and was said to be growing very near the sea. It is also mentioned as having been found at Witsands in the same region. Another three localities, given by Miss BARKER, are Ratel River, Bredasdorp (COMPTON 14768), Riversdale Division (J. MUIR, S.A. Museum, 6439), and Montagu, C.P. (K. H. BARNARD, S.A. Museum, 27362). *M. pustulata* has green leaves, flecked with liverish brown, which show about 20 nerves, with the surface between the nerves raised and densely pustulate, hence the name. The perianth segments are creamy white, the styles are pink.

Returning to the letter to THUNBERG referred to, it is learnt from it that in the previous years he set out on two long journeys into the interior only, viz. to Namaqualand (Kamiesberg !) and the Klein Roggeveld. His account for the year 1790 (see below), which must have reached BANKS in the first half of 1791, includes various expenses *re* an expedition to the Klein Roggeveld. As there was no such journey in 1791, these expenses were well ahead of it. It is curious that it would take MASSON that long before he could finally leave for the Klein Roggeveld. In this connection it may be reminded that the journey to Namaqualand first mentioned in the account of March 1, 1788, to January 1, 1789, only materialized in 1790.

Following are the two accounts enclosed with MASSON's letter to BANKS of June 29, 1792.

3. EXPENCES AT THE CAPE OF GOOD HOPE FOR THE YEAR 1790 ON ACCOUNT OF H BRITANNIC MAJESTY INCLUDING A JOURNEY FROM THE CAPE TO KLEYN ROGGVELT, RETURNING BY ZWARTBERG PLATT KLOOF & ZWELLENDAM &c

	R.Dol.
To a new Waggon	300
To a Saddle	42
To Garden Pots	14
To a Journey to the hot Bath	20
To a Hottentot on different occasions	16
To expences on various occasions	73
To a Chest	4
To a Basket	2
To Papper & linnen bags for Seed	31
To Hoops for the Waggon	4
To a Cask	4
To Tobacco	6
To 3 Waggon wheeps [!]	4
To 1 Box	1
To Liquors for the Journey	20
To 1 Box	2
To 1 D^{o}	4
To Powder & Shot	12
To various other articles for the Journey	41
To 2 Drivers for 5 Months	50
To board & lodging for 8 Months	320
To Room hire	80
	1050
[On the reverse]	1050
To Money expended on the Journey	100
To two oxen	24
To Boat hire on various occasions	20
To Slave hire on different occasions	23
To Money expended on different Journies round Cape	40
To keeping my horse	60
To Boxes for Seeds	26
	1343

Sir Joseph Banks

As stated in the heading of this account, MASSON returned to the Cape by way of the Zwarteberg, Plattekloof and Swellendam. We have not come across any records as to how long exactly the journey lasted, but according to one of the entries in the above account MASSON had a five months' journey in mind.

There is a duplicate of this account, obviously sent by another ship. Several entries on the duplicate show a different wording, in two cases the entry is, apart from the amount, altogether different. The tenth entry we find on the duplicate account replaced by "To *a Tilt* for my Waggon" (4 R.Ds), and the eighteenth "To a *coverlid* [coverlet !] *for my bed*" (12 R.Ds). The twelfth (the eleventh on the duplicate) is a little

more detailed, viz. "To Tobaco for the drivers", while the next entry is found in the proper spelling on the duplicate: "To Waggon Whips". So far the account.

4. EXPENCES FOR THE YEAR 1791

	R Dollar
To Elephant papper[105]	25
To Catridge D^{o}[106]	20
To a Hottentot a 3 R Dollar p^{r} month	36
To keeping my horse for 8 Months	40
To Cooley hire for carrying boxes to False Bay	8
To two Journies to False Bay	30
To a Journey to Cape False Horse hire and other expences	46
To Hout Bay; False Bay; Cape Bona	36
To Boat hire Cooley hire on various occasions	23
To Board & Lodging	480
To Boxes & Flower Pots	40
To expences on different Journies round the Cape	40
To Store House room for my Waggon for 8 Months	16
To other reparations for d^{o}	20
To a large Chest	10
To Baskets	10
To other expences	24
To a man who took care of my plants in my absence	12
Sum	916

This is as near an account as I can give, without entering into an endless minutia which would be of very little use: as I have don every exertion for the good of the service & keept as near as possible to the Sum proscribed [!]; which is very difficult considering the dearness of living here. I sent you a duplicat nearly to the Same amount by a dutch Ship.

As to the duplicate account sent by the Dutch ship, this too reveals a few differences in its entries, but the total amount is exactly the same. The fourth entry reads: "To Stabbling for my Horse for 8 Months 5RD p^{r} Month"; the fifth: "To carryin 2 boxes of plants to False Bay"; the seventh: there are two entries on the duplicate, viz. "To a Journey to Cape False for 12 day Horse hire for my Hottentot – – – 36", and "To other expences – – – 10"; ninth entry: "To Boxes sent home in the Leopard and Waakzamheid [Dutch ship, correct spelling *Waakzaamheid*] including boat hire"; the thirteenth: "To Store house room for my Waggon for 3 months – – – 6"; sixteenth entry: "To Baskets – – – 20"; and the seventeenth: "To Slave hire on different occasions" (24 R.D.).

The garden utensils (seed boxes, pots, etc.), mentioned in the accounts, were obviously required for MASSON's garden at Cape Town.

[105] Elephant paper: a size of drawing paper measuring 28 x 23 inches. Double Elephant is 40 x 26½ inches.
[106] Cartridge paper: a strong kind of paper, used in making cartridges and also for rough drawings—presumably in this case!

The next item is another letter, a very short one, written on the same day.

5. Cape of Good Hope 29th June 1792

Sir

I have drawn upon you for the expences of the current year. a Bill of one thousand Rix Dollars on Account of His Majesty payable to the order of Christian Hendreck Schrader Merchant in Amsterdam Which I hope you will honor

I am Sir with the greatest
respect you most obedient
Servant
Fran^s^ Masson

Sir Joseph Banks Bar^t^

Towards the bottom of the sheet, to the left of MASSON's writing, there is a short annotation in BANKS's hand, viz. "48 Stivers [Cape currency, properly spelt *Stuivers*] p^r^ Rixdollar accepted Oct 6 1792".

On the reverse of the sheet BANKS has jotted down an enumeration of the total amounts on MASSON's expenses accounts thus far received: "1st Bills . . . . 1450 (Rds). – 2nd Bill Jun 3d 1788 . . . . 800. – 3d bill Dec^r^ 24 1788 . . . . 1069. – 4th bill Dec^r^ 24 1789 . . . . 937. – 5th bill Sept. 3d 1790 . . . . 1343. 5. – May 8 92 6th bill Oct^r^ 15, 1791 at 48 Stivers p^r^ R^dr^ . . . . 1000." The last item on this list shows another, later date added to it. There were obviously two acounts, one of October 15, 1791, amounting to 916 R.Ds (the 1791 account included in this paper), and another bill for additional expenses (the remaining 84 R.Ds !) sent to BANKS nearly seven months later.

About a month after his return to England, MASSON wrote the following letter to BANKS:

6. Kensington August 28 1795

Sir

I am sorry that I did not mention to you before your departure for the country of a Set of bills which I drawed at the Cape for the last years expences, the Sum of 1140 Rix dollars. also at St Helena 16 L. Str [Pound Sterling] from Mr Porteus. as no hard money could be got at the cape. and also my passage home which will come to 80 L. wishing to pay Capt Thomas I spoke to Messrs Coutts & co[107] but finding they

[107] Banking House of COUTTS & Co. in the Strand, London.

had put all my money into the fonds except a ballance of 78 Pounds which I wanted for my present use they could not advance me the 80 pounds without an order from you. and I wish to have it settled as I believe the Cap^{t} means soon to go to sea. by the time of your return I shall be able to lay my accounts before you

I am Sir with the greatest
respect
your^{s} Fran^{s} Masson

Right at the bottom to the left BANKS has scribbled "Sept 2–3", obviously a reference to the day the letter was received. On the back of the sheet we find the following note by BANKS:— "wrote that I had accepted Porteus's Bill and would accept the Cape bill when it Came to hand also Sent him an order upon Coutts for £80. for his Passage ". So MASSON could pay Capt. THOMAS before the latter was sailing.

This letter is the last of the MASSON items at the California State Library.

As already mentioned, the manuscript collection of the University Library (Universitetsbiblioteket) at Uppsala, the old university town, once the home of LINNAEUS, father and son, THUNBERG and SPARRMAN, contains three letters MASSON wrote to his fellow-traveller THUNBERG. These letters, published before, without any annotation, as part of our THUNBERG paper[108], may be reproduced here with various explanatory notes.

FIRST LETTER TO THUNBERG

Cape of Good Hope 21st March 1793.

Much esteemed Friend

After so many years Shameful neglect of a friend to whom I ow so many obligations, for which I can make no apology; I take the liberty to address you from the Southern extreemity of Barbarous Africa where I suppose you are not ignorant of my long station. The sol intention of my second visit to the Cape being to furnish the Royal Garden at *Kew* with living Plants and as the mountains in the southern parts abound more with beautiful Frutices than the dry parched mountains of the interior parts I had orders to confine my investigation chiefly to them. I however broke through my orders and made one Journey to the Namaqua Land and another to the Kleijn Roggeveld [Klein R.] & Zwarte berg which proved productive of many beautiful plants. The rest of my

[108] This Journal, Vol. V, January, 1939, pp. 23–26.

time has been employed exploreing the Mountains of Hottentot Holland, French Hoek [Fransch H.], Roede Zant [Roodezand], Rivier Zonder Eijnde [Zonder End River].

Altho' our former collections of Cape plants was very numerous and compleat yet I think I have discovered some new Genera and added several new Species to the old. To the Genera Erica, Protea, Amaryllis, Haemanthus I have added Several new Species. of the Genus Massonia I have discovered four new Species, of the Genus Stapelia I have discovered more than twenty new Species. I have mad figures of most of them [Stapelieae !] and intends to give a Monography of them when I return to England.

To Insects & Fishes I have made a prety good collection but of the other parts of Natural history I have don nothing.

We have had here for some years a Collector from the Emperor of Germany but he has been very unfortunat in loosing so many Masters[109]. Several French Botanists has been here *en passant* one very recent a *Mr. Aubert* who has been on the Island of *Tristan d' Cunha* and made a curious collection. (He favoured me with a few Sps.) it is curious to observe that they seem to pertake of both continents viz. Africa & America. I observed some phylica[110] but no Erica or Protea.

Most of your old Friends are still alive. Mr. DE WITT of Roede Zant. THUNNIS Zöete Milk valleij, Juffrouw DE KOK Zee koe Rivier[111]. with

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[109] The collector referred to is GEORG SCHOLL, who had successively three German emperors of the House of Habsburg-Lorraine as his master, viz. JOSEPH II (1785–90), LEOPOLD II (1790–92), and FRANZ II (from 1792 onwards). MASSON is a bit exaggerating when writing that this collector lost so many imperial masters: there were only two who died previous to MASSON's letter, viz., JOSEPH and LEOPOLD.

[110] *Phylica*, L. (Rhamnaceae).

[111] The names of these three old friends as given by MASSON, are not correctly spelt. The persons referred to are:

Mr. DE WET of Roodezand (the present Tulbagh valley). About Sept. 26, 1772, THUNBERG, on his first journey into Caffraria, on which he was accompanied by AUGE, young IMMELMAN and sergeant LEONHARDI, arrived at a farm inhabited by "DE VETT [Swedish spelling!], a descendant of one of the French families which came with the first colonists that settled in this part of Africa, to lay our vineyards and plant fruit-trees" (THUNBERG, *Travels*, Vol. I (1795), p. 135; see also this Journal, Vol. V, Oct., 1939, p. 119). Later on, in Sept., 1773, and Dec., 1774, DE WET's farm was visited both by MASSON and THUNBERG when they were fellow-travellers on the two journeys into the interior mentioned before.

MARTHINUS AEGIDIUS THEUNISSEN (1744–1825), overseer of the Dutch East India Company's post Zoetemelksvlei at the Zonder End River. He was a Dutchman; in 1764 his people had come from Holland to settle at the Cape. He was appointed to the above post by Governor TULBAGH about 1772. Moreover, THEUNISSEN became a pioneer forester. At a certain period the Landdrost of the district (Swellendam) was commissioner of no less than four posts, viz., Zoetemelksvlei, Ziekenhuis (near Zonder End R.), Tygerhoek, and Rietvlei at the Buffeljagts River. Zoetemelksvlei was the main post, the other ones falling under it. THEUNISSEN appears to have alternately lived at Zoetemelksvlei and Rietvlei, though the former was his headquarters. THUNBERG, on his way home from his first journey into Caffraria, came to Zoetemelksvlei in Dec., 1772, shortly before MASSON and OLDENBURG arrived there early in Jan., 1773. MASSON found there a beautiful home,

many others. – Colonel GORDON often mentions you with respect and intends writing to you but at presents is to much employed in Political Affairs.

I have delivered to our Friend Mr. BRATT a Box containing Insects and a packet containing Plants which he promises to forward to your Correspondent in Holland if any Swedish Ship touches here I shall writ you more particularly

I am dear Sir withe the greatest esteem
Your very humble Servant
Frans. Masson

Chevalier Thunberg.

MASSON's remark about GORDON, who was then colonel in the service of the Dutch E. I. Company, is not quite clear. It is possible that the political situation gave rise to anxiety. Another two years only, and Holland would fall under the revolutionary government of France, resulting in the English fleet arriving at the Cape (see footnote 92).

SECOND LETTER TO THUNBERG

Cape of Good Hope 15th May 1793.

My dear friend,

Some months past I did myself the honor to writ you a letter with a box of Insects and a few Speciments of Plants which I thought would be acceptable to you. I delivered it to you correspondent Mr. BRATT to forward it; but in the present State of affairs in Holland he thought it best to deliver it to a Swedish India Ship bound to China it will be long in comeing but will be safer as we hear that France has declared war

belonging to the Company's forester. In Oct., 1772, thus on the return journey, THUNBERG and his party stayed for several days at Rietvlei "to arrange the collections we had made, and to repair our wretched carriage, which had been shattered to pieces by the strong and mountainous roads . . . . Not far from this farm of the company's, which particularly furnishes it with large timber, is a large wood, called Grootvader's Bosch. . . . . " (THUNBERG, *Travels*, Vol. I (1795), pp. 168–9.) PATERSON visited Rietvlei in 1777 and mentions MARTH. THEUNISSEN, the Company's overseer. Much later, in 1804, Dr. H. LICHTENSTEIN, when on a return journey from Swellendam to Cape Town, stopped at Zoetemelksvlei, to examine some buildings that had been erected by the postholder THEUNISSEN on the other bank of the Zonder End River. For most of the above records we are indebted to MUIR's article on THEUNISSEN in Die Huisgenoot, March 9, 1934.

Juffrouw KOK (not *de* Kok) of Seekoe River. The widow of JOHANNES JACOBUS KOK (see footnote 54) who occupied the farm at Seekoe R. In 1786 the widow was mentioned for the first time and in that same year the farm was taken over by JACOBUS KOK, JACOBSZ., evidently the very person who was reported by General JANSSENS in 1803 as having fled thence from the Kaffirs (FORBES, in his thesis *The Expanding Horizon*, 1957).

against that Republic. I have a small collection of beautiful exemplaars of plants of Botany Bay which I wish to send to you but for the same reason I deferre it to another opportunity.

My long residence at the Cape enabled me to make some new Botanical discoveries; altho' my Journies has not been So far as when we travelled together; my farthest Journey has been only to the Camies Berg [Kamiesberg, Namaqualand]. I have discovered many N : Sp : of Staplia near thirty Sps. many N : Species of Amaryllis, Haemanthus, Massonia Albuca etc. I think now to make another Journey into that country, which will finish my perigrinations here when I think of returning home, and Shall be happy to communicat every thing that may be worth your notice.

I have a good collection of Insects. I have found a red *Blassop*[112]. but have only one Specimen.

I am dear Sir with the greatest
Esteem yours
Francis Masson

Many of your old friends still exist and have often enquired for you viz.
De Witt of Rode Zant
Thunnis, Zoet Melk Valeij
Auge is yet alive but live far in the country[113].

The letter is addressed in French, viz.
Monsieur Charles Pierre Thunberg
Chevalier e Professeur de Botanique
à Upsal
en Swede.

Masson's plans for a second journey into the Kamiesberg region, referred to in the above letter, materialized later in the year (1793), according to the notes on several of his botanical drawings. This expedition is represented first by Nos. 93 and 105, which are of specimens found

[112] Masson refers here to one of the family of grasshoppers and locusts, Acridiidae Order Orthoptera. The "Blaasop" (Cape Dutch, means blown up, inflated; wrongly spelt by Masson), *Pneumora scutellaris*, is a locust, the male of which has a sound-producing organ on the abdomen, which is greatly inflated (hence the name !) and intensifies the sound. However, its colour is a uniform green, and there is no such thing like a *red* "Blaasop". Was it perhaps the Red Locust, *Cyrtacanthacris septemfasciata*, he found?

The above entomological notes have been taken from Gilchrist, *S.A. Zoology* (1911).

[113] At the time Masson wrote this letter, Jan Andries Auge was probably living at the farm of a friend on the Gamtoos River. He was then 82 years of age and totally blind.

in July, 1793, when he was presumably outward bound, at Rhenoster Fontein near Lange Vallei, probably that what is now mapped 13 miles W.S.W. of Clanwilliam. Following are the notes appearing on these two drawings.

No. 93. "Amaryllis sp. nova. Rhinoceros Fountain ultra [beyond] Lang Valley, July 12th. 1793. Natural size." Beneath in a later hand: "*Strumaria truncata, Jacq. no! Corolla similis. A. tenera. See Baker. Amaryllis* 104 *where this is erroneously identified Hessea stellaris Salisb. with S. truncata.*" The work referred to is BAKER's *Handbook of the Amaryllideae* (1888). *S. truncata,* Jacq. is the valid name of this species, which is known from various localities, as Strandfontein near Clanwilliam, Bitterfontein, Sandkraal and near Klaver in the Van Rhynsdorp Division, Garies, Spektakel and Mierenkasteel (or Meerhoffs Casteel !) in Namaqualand.

No. 105. "Rhinoceros Fountain juxta Lang Valley, July, 1793. Foleis margini purpurascens. Stamina to be made a little lighter, inside of the corolla to be brightened." (Transl.: . . . near Lange Vallei . . . Leaves growing purple at the margin . . . .). No name is given. Below in pencil in a later hand: "*Haemanthus undulatus Herb. See Masson's specimen in Herb.*" This plant, still known under the name *H. undulatus,* Herb., has since been found in some places in the Clanwilliam region (*inter alia* Pakhuis and Olifants River Valley), in the Van Rhynsdorp Division (foot of the Van Rhyns Pass), and also in Namaqualand.

There are another three drawings, Nos. 131, 111 and 37, showing plants collected on the outward bound journey, according to the notes written on them.

No. 131 is the picture of a plant, collected at Seekoe Valley, in the same month as the latter species. The following notes appear on its face: "Gethylis undulata Herbert. Africa Australi [Southern A.] Zee Thoe Valley. Coll. Julio 1793. Fl. in Hort. Masson Mart 1794." Beneath in a later hand: "*See Journ. Bot.* 1885, 227." The paper referred to is *A Monograph of the Genus Gethyllis,* by BAKER. There are no known specimens of this species which flowered in MASSON's garden at Cape Town. It obviously has never been rediscovered.

Drawing No. 111 is of a plant found on the top of the Kamiesberg, in 1793. The notes on the face read as follows: "Massonia echinata? Fl. in Hort. Massoniana May, 1794. Ground of the leaf to be darker. Petals to be brightened up with white." Below in a later hand: "*See specimen in Herbarium Massonia echinata.*" On the back, revealed through a window cut in the paper on which it is pasted, there is an additional note in MASSON's hand: "summis montanum (Camiesberg) in fisures rupis

planis vastis Granit 1793." (Transl.: . . . . on the summits of the mountain (Kamiesb.) in rock clefts on arid plains . . . .). *M. echinata*, L. f., a valid species, has been collected by later botanists at Van Rhyns Pass and on the summit of this Pass (Van Rhynsdorp Division), Grasberg in the Calvinia district, Karroo Poort near Ceres, and also in Little Namaqualand.

Finally drawing No. 37, showing the following notes in MASSON's hand on the face: "Fl. aurantiaca viscoides Planta parasitica ad arbores Mimosa nilotica. Namagualand Groen rivier, August, 1793." (Transl.: Flowers orange, viscid. A parasitic plant on M. nilotica (= *Acacia karroo*, Hayne) trees.) Added in a later hand: "*Loranthus oleafolius Ch. & Sch.*" The locality, Groen Rivier, mentioned by MASSON, is N.W. of Kamiesberg. This parasitic plant, still known as *L. oleaefolius*, Cham. et Schl., has been later found not only in the Clanwilliam region (Olifants River, Lange Vallei), but also in the Eastern Cape (near Zwartkops and Sundays Rivers in the Uitenhage district, near Despatch on *Salix capensis*, in the vicinity of Grahamstown). As to the colouring of the flowers, it should be pointed out that it is the unopened corolla which is of a bright orange-scarlet colour.

Follows the description of two drawings, Nos. 128 and 117, made of plants which were obviously collected on the way home to the Cape, according to the notes written on them, viz. at Meerhoffs Casteel (a locality known under various spellings) in the Van Rhynsdorp Division, and near the Olifants River respectively.

No. 128. "Gethylis latifolia. Meerhofs Casteel Sept. 1793. Fl. in Hort. Masson Feb. 1794. Scop. striata fol. glauca. [G] lanceolata Thunb." (Transl.: . . . Stems striate, . . . leaves glaucous . . . .) Beneath in a later hand: "*Baker in Journ. Bot. tab. 259: p. 228.*" This species is only known from the copy of MASSON's drawing, illustrating BAKER's paper on *Gethyllis*, in the Journal of Botany (1885). Miss BARKER and Dr. LEWIS once tried to trace the old locality Meerhoffs Casteel, but the area is all cultivated now and no one they asked seemed to know the name.

No. 117. We saw a tracing in colour, made from this drawing, by Miss BARKER in 1937. The picture, of "Lachenalia succulenta", shows various notes, carefully traced, on the face. Beneath the drawing of the plant MASSON has written:— "Lachenalia Succulenta Africa australi [Southern A.] Karó Olifants rivier octobri 1793", while in the left bottom corner of the sheet we find the inscription "F. Masson" in the same hand. The following notes, also in MASSON's handwriting, are in the top corner to the right of the two racemes: "Corolla albescens Petalis versus apice deluti [= dilatis ?] purpurascens palens Olifants rivier collibus aridis octobri 9th 1793 Pedunculi alba." (Transl.: Corolla becoming white, with

petals spread towards the apex; turning a whitish purple . . . , on dry hills . . . Peduncles white.) The word "deluti" in this short description is inconceivable, but it has occurred to Miss BARKER, who knows the genus well, that the word MASSON meant to use actually was "dilati", meaning spreading, as the petals do spread at the tip. Grammatically, it should be "dilatis", being a characteristic of the petals. We thought it justified to give the translation of the latter word. Finally, there is a short reference, written down by a later botanist, and which reads as follows:— "*Lachenalia succulenta Masson*! *Journ. Bot.* 1886, 336." The paper referred to is BAKER's *New Cape Liliaceae.* As to the identity of this species, Miss BARKER is convinced that it is synonymous with *L. patula,* Jacq., the latter being the valid name. It has been collected a number of times on the Knersvlakte, quartz-patches in the Van Rhynsdorp Division.

The localities mentioned on these drawings give a rough idea of the route taken by MASSON on his second journey to the Kamiesberg.

THIRD LETTER TO THUNBERG.

Addressed to:

Charles Peter Thunberg
M.D.
Knight of the Order of Vasa. Professor
of Botany at
Upsal.

London Nov. 29 1795.

My dear Friend,

I have the pleasure to inform you of my safe arrival here about 4 months ago. I have also had the pleasure to receive your obliging letter dated October 14th 1794 accompanying your prodromus[114] for which I return you many thanks. I left the cape Good Hope 17th of last March. with a collection of growing Plants which I have been so fortunate to bring Safe home all my Stapelei (about 30 Spec.) are now growing in Kew Garden. Many of your old friends are yet alive at the Cape. viz. THUNES & his wife. old DE WITT of Roode Zant etc. but the whole colony has for some years been falling in decadence and at last almost General State Bankruptsy. having nothing but wretched papper money. It is now fallen into the hands of the English whether they will recover its

[114] C. P. THUNBERG, *Prodromus Plantarmu Capensium,* quas, in Promontorio Bonae Spei Africes, annis 1772–1775, collegit. Pars prior (Classes I–X), tab. 1–3. Upsaliae (1794). A second part (Cl. XI–XXIV) appeared in 1800.

credite or whether it will remain long in their hands is difficult to Say.

Last year I did my self the pleasure of writing to you & sent a small collection of plants. which Mr. BRATT forwarded by a Dutch ship but I fear that they have fallen into the Hands of their enemies and consequently lost. If there is any plants or insects which I can send to you let me know.

Excuse this short Epistle an believe dear Sir

with the greates respects
y Servat
Franc Masson

The direction to Mr. MASSON is:
Mr. Francis Masson.
at Mr. Barens's palace gate
Kensington.
(or the letter may be directed to
him at Sir Joseph Banks's K.B.
Soho square.)

The above letter concludes the MASSON correspondence 1786–95.

It is to be deplored that there is no written account of MASSON's second sojourn at the Cape, during which, as we have seen, he went on three major expeditions up country, on which he must have gathered many an interesting and even new species of plant. This time he was to stay for over ten years, during which he was regularly sending home considerable collections of plants and seeds. Many of the plants collected MASSON grew in the little garden he had established at Cape Town during that time. In this connection we may refer to the notes on some of MASSON's drawings in which the depicted plants are said to have flowered in MASSON's Garden or "Hortus Massoniana" [!].

In his letter of March 21, 1793, to THUNBERG, MASSON refers to a collector from the Emperor of Germany (see footnote 109), who had stayed at the Cape for some years. This man cannot be but GEORG SCHOLL[115], an Austrian who, according to a statement made by JACQUIN[116],

[115] SCHOLL arrived at Cape Town together with FRANZ BOOS in May, 1786, viz. four months after MASSON's arrival in January. BOOS and SCHOLL had been ordered by Emperor JOSEPH II to visit Mauritius and bring back with them, for the benefit of the Imperial Gardens at Schönbrunn, Vienna, a large collection of tropical plants, which had been made by the Director of the Gardens there. They were only to call at the Cape incidentally.

BOOS, born in Germany, was a botanist as well as a gardener, and evidently the leader of the expedition. SCHOLL, who was chosen to accompany him, was a mere gardener and probably with very little knowledge of plants.

BOOS stayed only a year at the Cape, left again early in 1787 to proceed to Mauritius, and also to the island of Bourbon, to obtain the plant collections gathered there, which were the original object of the voyage, leaving SCHOLL behind at the Cape. He was back again at the Cape in January, 1788, having brought with him

accompanied MASSON and also GORDON on some of their journeys. Nothing is known about other fellow-travellers MASSON's during this period.

In March, 1795, MASSON left the Cape for good. Back in England he prepared his *Stapeliae Novae.* He was only to stay in his home country for just over two years: in September, 1797, when the last numbers of the above work were about to be published[117], he left on another errand, this time for North America, whence he was not to return. At the end of December he arrived in New York after an eventful crossing, according to the following quotation from a letter he wrote thence to the younger AITON on January 1, 1798[118]:— "We arrived here in great distress after a passage of 4 months from Gravesend, during which period we experienced many difficulties. Near the Western Isles [Azores] we were stopp'd by two French Privateers, one of which boarded us, examined our Papers & let us pass. Nothing happened afterwards till the eighth of November towards night saw 3 sail bearing upon us, one of which was a French Pirate belonging to St. Domingo, who fired several shot and a volley of small arms into our ship, & soon after boarded and took possession of us." They were then put on board a Bremen vessel bound for Baltimore, and after having suffered many hardships from weather, want of water, and provisions, they were ultimately taken on board another ship, and so to New York. After some stay here MASSON went to Niagara; the latter part of the route he was coasting along the shore of Lake Ontario. From Niagara he journeyed to Queenstown, thence to Fort Erie. He returned to Niagara, subsequently reaching Montreal. The particulars of this journey are extracted from a letter, dated October 18, 1798, MASSON wrote to BANKS from the latter place. In a letter bearing date March 18, 1806, sent from Montreal by a Mr. W. VAUGHAN to the younger AITON, it is announced that MASSON died in December of the previous year.

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280 boxes of tropical plants. But when a ship came along early that year to take them home, it was impossible to get all the material on board. So Boos sailed away with as many boxes as possible, while SCHOLL stayed behind to collect additional Cape plants and to take charge of the remainder of the Mauritius and Bourbon plants. He was to remain there for twelve years in all, during which time he had ample opportunity to go on collecting trips. He returned to Vienna in 1799.

It is most unlikely that MASSON had Boos in mind when writing to THUNBERG. Boos was at the Cape not longer than a year and a couple of months, and there are no records of MASSON and Boos journeying together.

The above details we owe to S. GARSIDE's article on JACQUIN, this Journal, Vol. VIII, July, 1942, pp. 210–14.

[116] GARSIDE, *loc. cit.*, p. 213.

[117] See MASSON's short note about the sets of his *Stapeliae Novae*, dated August 29, 1797, in Part IV of this paper.

[118] The information about this period of MASSON's life, including the above quotation from his letter to the younger AITON, and the reference to VAUGHAN's letter, we owe to J. BRITTEN's paper on MASSON, Journal of Botany, Vol. XXII, 1884, p. 122.

There is very little known of MASSON's activities during this last period of his life. But there are in the British Museum specimens of plants MASSON has collected among the Great Lakes, and sent to BANKS. Suffice it with mentioning here that they include *Trillium grandiflorum* (Liliaceae), a striking plant with its white flowers changing to a rose-colour (actually the 3 big inner perianth segments—much longer than the outer ones—the most prominent part of the flower), collected by him in Upper Canada. It is a valued plant in European gardens.

(*To be continued*)

ERRATA.

FRANCIS MASSON, Part II, this Journal, July, 1959: p. 176, footnote 53, read: A. soccotorina; p. 128, footnote 68, read: *Lachenalia* spp. (instead of Lachanalia).

HUERNIA LEACHII—A NEW SPECIES

By J. J. Lavranos.

(With Plates XXIX and XXX.)

Huernia Leachii Lavranos, sp. nov.

Floribus affinis *H. macrocarpae* Spreng. sed papillatione corollae densiore, caulibus longioribus procumbentibus cylindratisque differens; habitu affinis *H. pendulae* Bruce sed caulibus crassioribus acuminatibus, florum colore, lobis intermediis corollae minoribus, corona exteriore majore differens.

Caules decumbentes, tenus 150 cm. longi 5—8 mm. crassi, glabri, obscure quadrangulati et cylindrati habitu; folia 2—2½ mm. longa, acuta; flores 2—3 aggregati; bracteae lineares acutae 3—4 mm. longae; pedicelli circa 15 mm. longi, teretes, paene glabri; sepala acuminata 5—6 mm. longa, minute papillosula; corolla late campanulata, 15 mm. longa, inter apices loborum circa 20 mm. lata, extus pallide lutea, maculis minutis purpureis punctata et papillis albescentibus brevisque induta, intus pallide lutea, transversa fusco-purpura striata et anguste fusco-purpura marginata, ubique papillis parvis albescentibus vel purpureis induta; lobi deltoidei acuti 8—9 mm. longi, basi circa 10 mm. lati; lobi intermedii minuti, obsoleti; basis tubi uniforme fusco-purpurea, brevius papillata; corona exterior fusco-purpurea 3½—4 mm. diametro, basi tubi adpressa, lobis obscure crenulatis ad apices indentatis, latioribus quam longi; coronae interioris lobi 2½—3 mm. alti, basi fusco-purpurei, supra antheras incumbentes et conniventes, parte superiore flava, fusco-purpura marginata.

Portuguese East Africa, 10 miles south of Vila Pery on the Umtali–Beira Road, Leach 5641 (PRE, Holotype).

Distribution: For some miles south of the type locality but not otherwise recorded.

Stems decumbent or slightly ascending, up to 150 cm. long, 5—8 mm. thick, glabrous, green to purplish brown, obscurely 4-angled and almost cylindric in habit, with a transverse groove above each leaf.

Leaves 2—2½ mm. long, tooth-like, at right angles to the stem, persistent during two first years of growth.

Flowers two or three together from lower half (but not from base) of young stems, developed successively.

Bracts linear, acute, 3—4 mm. long.

Pedicel terete, reddish purple, about 15 mm. long, almost glabrous with a few small wart-like dots.

Sepals linear-acuminate, 5—6 mm. long, minutely papillate, 3-nerved.

Corolla broadly campanulate, 15 mm. long, approximately 20 mm. broad between apices of lobes; *lobes* deltoid-acuminate, about 10 mm. broad at base, 8—9 mm. long; outer surface with 5 nerves, the median nerve very prominent and ridge-like; intermediate lobes minute, almost absent; *outer surface* cream coloured, rather rough, fairly densely covered with minute purple dots and short whitish papillae; *inner surface* cream with continuous transverse dark purple bands, narrowly margined with dark purple, covered with little bristle-like purple or whitish papillae throughout; base of tube almost uniformly dark-purple, where the papillae are shorter than elsewhere.

Outer corona dark purple, adpressed against corolla-tube, $3\frac{1}{2}$—4 mm. in diameter, the lobes broader than long with obscurely crenulate margins and a shallow indentation at their apices.

Inner corona lobes $2\frac{1}{2}$—3 mm. high, dark purple at base, incumbent upon the anthers and connivent, the upper half yellow, margined with dark purple.

In floral characters *H. Leachii* appears to be most closely allied to *H. macrocarpa* Spreng. from Eritrea. Both species have a broadly campanulate corolla, yellowish with transverse dark purple bands and very small intermediate lobes. The transverse dark purple bands appear to be broader and more continuous and the inner corolla-surface more densely papillate in the new species while in the latter the papillation extends to the corolla-tube which is not the case with *H. macrocarpa*. The structure and even the colour of inner and outer corona are practically identical in both species. In habit, however, there is a wide difference between these two species, the stems of *H. Leachii* being decumbent, very long, relatively thin, almost cylindrical and tapering to a rather acute point, while *H. macrocarpa* has much shorter, thicker, 4—7-angled erect stems with very prominent teeth.

H. Leachii resembles *H. pendula* Bruce in habit, but the flowers of the latter species are smaller, uniformly dark purple-brown on the inner corolla-surface, with prominent intermediate corolla-lobes and a relatively smaller outer corona. Moreover, the stems of *H. pendula* are thinner and less tapering than in the new species from which they also differ by the absence of the short tooth-like leaves.

PLATE XXIX.
Huernia Leachii Lavranos sp. nov.
Photograph: Division of Botany, Pretoria.

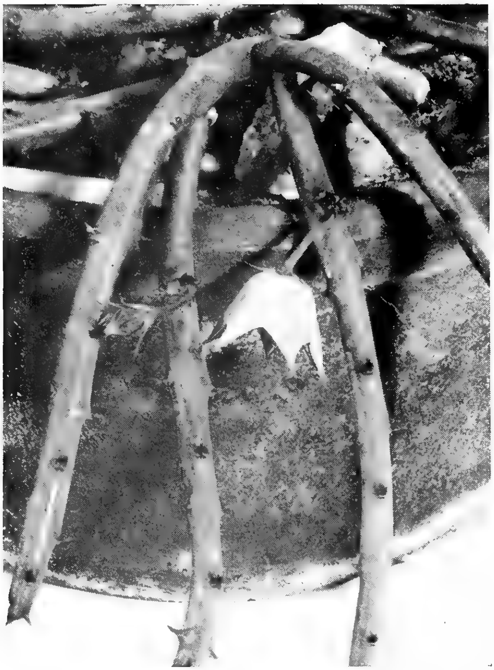

PLATE XXIX A.
Huernia Leachii Lavranos sp. nov., actual size.
Photograph: Division of Botany, Pretoria.

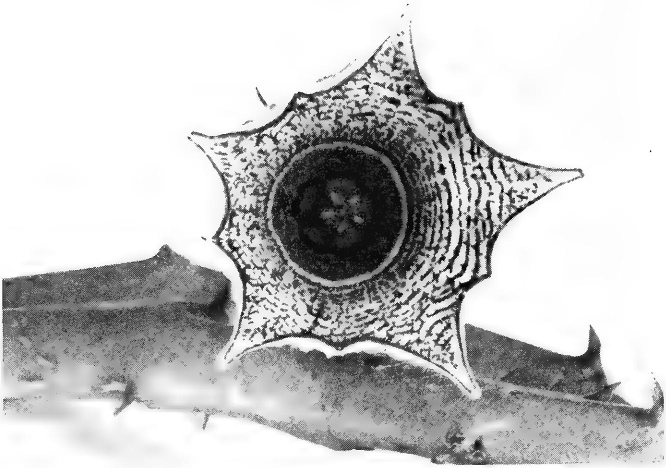

PLATE XXX.
Huernia Leachii Lavranos sp. nov. Enl. × 3.
Photograph: Division of Botany, Pretoria.

H. Leachii clearly belongs to the section *Plagiostelma* K. Schum. in view of the structure of the inner corona and must, for the same reason, be placed in White and Sloane's *macrocarpa-brevirostris* group.

This interesting new species was first collected in 1956 by Mr. L. C. Leach of P.O. Greendale, Southern Rhodesia, growing on the lower slopes of a large granite kopje 10 miles south of Vila Pery in Portuguese East Africa, in association with *Euphorbia* sp. aff. *E. memoralis* R. A. Dyer. *Aloe cameronii* and a succulent Plectranthus. Mr. Leach writes us: "The plants were growing in the peat-like rootmasses of coarse perennial grasses, the stems trailing or erect, supported by the grass, only the tips of the stems showing. The longest stem I measured was 5 feet long. The humidity of the area would appear to be high".

Living material was sent by Mr. Leach to the Division of Botany at Pretoria and flowered in the author's garden at Bryanston, Johannesburg, in mid-April 1959, when this description was drawn up and photographs taken.

The author wishes to thank the Chief, Division of Botany, Pretoria, and his staff for the living material, the photographs accompanying this text, for allowing him to study herbarium material of many species of Huernia for reasons of comparison, and for reading and correcting this description.

Finally, he wishes to express his appreciation for much valuable information and for additional living material to Mr. L. C. Leach, after whom this remarkable species is named.

A NEW ALOE FROM NORTHERN RHODESIA

By G. W. Reynolds.

(With Plates XXXI, XXXII.)

Aloe veseyi Reynolds. Species nova, affinis *A. confusae* Engler et *A. penduliflorae* Baker, ab *A. confusa* caulibus crassioribus brevioribus, foliis latioribus, floribus brevioribus angustioribus, ab *A. penduliflora* racemis longioribus, multo laxioribus differt.

Planta caulibus et foliis et inflorescentia pendentibus; caulibus 30—40 cm. longis, 2 cm. crassis. *Folia* c. 12, rosulata, 40—50 cm. longa, basi 3 cm. lata, sensim attenuata, falcato-decurva, pendens; *supra* planiuscula vel leviter canaliculata, maculata; *subtus* convexa, maculata; marginibus dentibus cartilagineis 1—2 mm. longis, usque 20 mm. distantibus armata.

Inflorescentia pendens, 2—4-ramosa, c. 60 cm. longa. *Racemi* arcuato-adscendentes, conici, laxi, usque 12 cm. longi, 7 cm. diam. *Bracteae* angustae, lanceolatae, 6 mm. longae, 3 mm. latae, scariosae, albidae, 3-nervatae. *Pedicelli* 14 mm. longi. *Perianthium* luteum, anguste cylindrico-trigonum, 25 mm. longum; *segmenta exteriora* per 5—6 mm. libera; *interiora* latiora. *Antherae* 3—4 mm. exsertae. *Stigma* demum 4—5 mm. exserta. *Ovarium* viridulum, 4 mm. longum, 2 mm. diametro.

Habitat: Northern Rhodesia: On precipice faces at Kalambo Falls, 22 miles north of Abercorn, cult. Johannesburg, fl. 29 March 1959, Reynolds 8659 holotype (PRE), isotype (K, SRGH).

Our new species is named after Mr. L. D. E. F. Vesey-FitzGerald (Principal Scientific Officer, International Red Locust Control Services, Abercorn, Northern Rhodesia), who discovered plants in July 1939 at Kalambo Falls, 22 miles north of Abercorn.

In August 1954 I visited Kalambo Falls but was unable to secure plants. In July 1958, when Dr. N. R. Smuts and I visited Kalambo, we were fortunately able to get two large plants which have grown well in Bryanston, Johannesburg, where they flowered in March—April, 1959.

A. veseyi grows on both sides of Kalambo Falls (703 ft.), the largest number being found on the southern side, facing west on a perpendicular rock face about half a mile broad and 400—500 ft. deep—impossible to each without block and tackle.

Plants cling to this precipice face, with their stems hanging downwards. The leaves are falcately decurved with their apices pointing downwards, while the slender 3—4-branched inflorescence is also pendent with only the racemes upturned.

A. veseyi appears to be nearest allied to *A. confusa* Engler which occurs at Lake Chala, a water-filled crater on the Tanganyika-Kenya border 7 miles north of Taveta. *A. veseyi* differs from *A. confusa* chiefly in having much shorter thicker pendent stems, broader more densely rosulate pendent leaves, and shorter narrower flowers. Another noteworthy difference is that the leaf sap of *A. confusa* is deep purple and stains clothing, while in *A. veseyi* it is yellowish orange.

Another species to be considered is *A. penduliflora* Baker, sent by Sir John Kirk to Kew from Zanzibar in 1884, and described when it flowered in Kew in August 1888. The precise locality of origin of this species is unknown, and there are (it seems) no published figures. According to description, *A. penduliflora* is a near ally in leaf characters, bracts, pedicels and hanging inflorescence with upturned racemes, but differs in having a much more densely flowered raceme that is only 5 cm. long. Berger states that when he saw the plant in Kew in Sept. 1905, it had a stem 2—3 m. high and 3—4 cm. diam.

Judging from the name, *A. pendens* Forsk. from the Yemen seemed a possible affinity, but the figure in *Bot. Mag. t.* 7837 (1902) depicts a plant in all ways distinct from *A. veseyi*.

Description: *Plant* with stems, leaves and inflorescence all hanging downwards on precipice faces.

Stem about 30—40 cm. long, 2 cm. thick, with offshoots from base forming 5 or more rosettes of leaves per plant.

Leaves about 12, rosulate, 40—50 cm. long, 3 cm. broad at base, gradually narrowing to a long-pointed apex, all falcately decurved and pointing downwards; *upper surface* dull grey-green with reddish tinge, flat to slightly canaliculate with numerous spots throughout, the spots dull white, lenticular to narrowly elliptical; *lower surface* rounded, similar to upper surface; *margins* armed with firm cartilaginous deltoid teeth 1—2 mm. long, up to 20 mm. apart, larger near base, gradually smaller to obsolescent upwards.

Inflorescence a slender 2—4-branched panicle about 60 cm. long, pendent, with only the racemes arcuate-ascending.

Peduncle slender, basally flattened and 6 mm. broad, 2—4-branched from about the middle, the branches arcuate-spreading slightly downwards, with the racemes arcuate-ascending, lowest branch subtended at

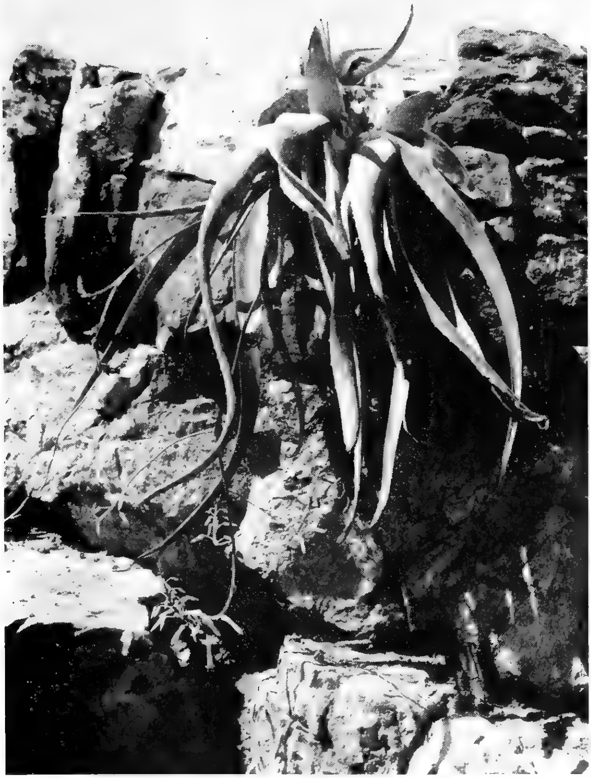

PLATE XXXI. *Aloe veseyi* Reynolds.
Plants from Kalambo Falls, Abercorn District, Northern Rhodesia, cult. Bryanston. Johannesburg. Fl. 29 March, 1959, × 1/8 approx.

Fig. 1.

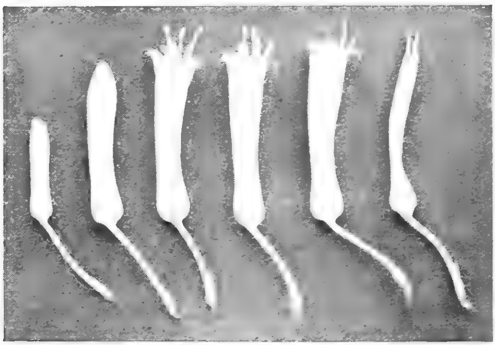

Fig. 2.

Plate XXXII. *A. veseyi* Reynolds.

Fig. 1.—Pendent inflorescence, × 1/8 approx.

Fig. 2.—Flowers 1/1, from bud to post-pollination stage.

base by a thin, scarious, 3—5-nerved bract which is long-pointed, 15 mm. long, 6 mm. broad at base.

Racemes cylindric-conical, rather laxly flowered, the terminal 12 cm. long, 7 cm. diam., about 30-flowered, the lateral a little shorter, the buds and flowers nutant.

Bracts narrowly lanceolate, long-pointed, 6 mm. long, 3 mm. broad, thin, scarious, white, 3-nerved.

Pedicels 14 mm. long, spreading horizontally to curved slightly downwards.

Perianth narrowly cylindric-trigonous, 25 mm. long, pale yellow, obtuse at base, 5 mm. diam. and greenish yellow across the ovary, thence slightly trigonous and enlarging to the throat with the mouth wide open and 10 mm. across; *outer segments* free for 5—6 mm., with 3 orange nerves, the apices orange-brown tipped, spreading to recurved; *inner segments* themselves free but dorsally adnate to the outer for 18 mm., broader than the outer, and with more obtuse, more spreading apices.

Filaments filiform-flattened, white within the perianth, the exserted part lemon, the three inner narrower and lengthening before the three outer with their anthers in turn exserted 3—4 mm. *Stigma* at length exserted 4—5 mm. *Ovary* green, 4 mm. long, 2 mm. diam.

ACKNOWLEDGMENTS.

I am deeply indebted to:

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Mr. L. D. E. F. Vesey-FitzGerald, Principal Scientific Officer, I.R.L.C.S. Abercorn, for hospitality and much assistance when I investigated the Aloes in the Abercorn district, and also for plants of other Aloe species from several localities.

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SOUTH AFRICAN IRIDACEAE. THE GENUS TRITONIOPSIS.

By G. J. Lewis.

(*National Botanical Gardens of South Africa, Kirstenbosch.*)

(With Plate XXXIII.)

The genus *Tritoniopsis* was established by Dr. L. Bolus in 1929, with a single species, *T. leslei*. In the same paper (S. Afr. Gard. Vol. 19, p. 123) Dr. Bolus gave an account of the genus *Hebea*, sensu L. Bolus non (Pers.) Hedw. f., and made several new combinations. Writing of *Tritoniopsis*, Dr. Bolus remarked as follows: "Besides having marked protandry in common with *Hebea*, this new genus, *Tritoniopsis* (= with the appearance of *Tritonia*) also has the unguiculate (though in a less degree) perianth segments, apiculate anthers, and the angular seeds of *Hebea*, as well as the same kind of leaf, bract and capsule". The only character by which these two genera were separated was the symmetry of the flowers, the one having actinomorphic and the other zygomorphic flowers.

In 1939 Foster published a paper entitled "A Current Misinterpretation of Gladiolus subgenus Hebea Pers." (Contrib. Gray Herb., Harvard Univ., No. 127, p. 35), in which he pointed out that the group of species segregated from *Gladiolus* under the name *Hebea* by Dr. L. Bolus (and followed by myself) did not accord with the original concept of *Gladiolus* subgenus *Hebea* Pers., but was the same as Baker's concept of *Gladiolus* subgenus *Schweiggera* (E. Mey. ex Baker). Foster agreed with the South African botanists in regarding these species as generically distinct from *Gladiolus* but, as he explained, a new name was required for the genus since the name *Hebea* was not in order, nor was it possible to raise subgenus *Schweiggera* E. Mey. ex Baker to generic rank under that name as it had previously been used. He therefore provided the name *Exohebea*, with a Latin diagnosis of the genus, made a number of new combinations, and described one new species. Foster remarked also that with regard to its various characters, the genus was clearly related to the monotypic genus *Tritoniopsis*.

In the second edition of the Genera of South African Flowering Plants, published in 1951, Phillips sank *Tritoniopsis* under *Exohebea* (p. 220), and while agreeing with him in considering that these should be regarded as one genus, I can find no reason for his use of the more recent name, which should be substituted by *Tritoniopsis*. The original brief generic description requires amplification and a slight amendment to cover the majority of species in which the flowers are zygomorphic.

Another species which undoubtedly belongs in *Tritoniopsis* is one which was placed in the monotypic genus *Tanaosolen* by N. E. Brown in 1932—this genus was upheld by Phillips in the second edition of his Genera of South African Flowering Plants (p. 220). When he described this species as *Tanaosolen nudus*, N. E. Brown was not aware that it had been named *Ixia nervosa* by Baker, who placed it in *Ixia* on account of a superficial resemblance to one or two of the long-tubed species. However, the deep-seated corm, leaves, bracts, floral characters, capsules and seeds are all like those of various species of *Tritoniopsis*, and although the slender perianth tube is longer than in the majority of species, there are two in which it is as long or even longer, as well as one or two intermediate between these and the more common short-tubed species.

As I have mentioned in previous papers on the Iridaceae, the length of the perianth tube by itself is not a character to which any generic importance can be attached as both long- and short-tubed species occur in a number of genera, such as *Romulea*, *Ixia*, *Babiana*, *Gladiolus*, etc., nor is the symmetry of the flower by itself a reliable character as both actinomorphic and medianly zygomorphic flowers sometimes occur in the same genus, e.g. *Babiana*, *Lapeirousia* and even *Gladiolus*, the last a very large genus with predominantly zygomorphic flowers.

Tritoniopsis is a fairly small genus confined to the south-western districts of the Cape Province, from Clanwilliam and Ceres to the Cape and along the coastal mountain ranges eastwards as far as George. The species grow on mountain slopes and plateaux, or at the foot of mountains, and nearly all flower during the summer and autumn months.

The deep-seated corms, usually wedged among stones or rocks, can only be dug up with difficulty in most of the species, and these organs are missing from almost all of the old collections I have examined. An interesting feature about the plants is the long delay between the development of the flower spike and appearance of the flowers; by the time the flowers have opened the bract and bracteoles, which are at first herbaceous, are more or less dead and brown or reddish in colour.

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Living plants of all except one species have been examined, and in addition material in collections in the following institutions:

Bolus Herbarium, University of Cape Town	BOL
South African Museum Herbarium, National Botanic Gardens, Kirstenbosch	SAM
Compton Herbarium, National Botanic Gardens, Kirstenbosch	NBG
Conservatoire et Jardin Botanique, Geneva	G
Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie, Paris	P
Royal Botanic Gardens, Kew	K
National Herbarium, Pretoria	PRE
Botaniska Museet, Uppsala	UPS
The Linnaean Society of London	LINN
Jardin Botanique de l'Etat, Bruxelles	BR
Gray Herbarium, Harvard University	GH

Thanks are due to the Directors and Curators of those institutions which provided facilities for examination of the specimens, or who kindly sent material on loan.

For advice on some problems of nomenclature I wish to express my thanks to Dr. E. Schelpe and Dr. R. A. Dyer, and for assisting me in collecting living plants I have to thank Prof. H. B. Rycroft and Miss W. F. Barker.

TRITONIOPSIS

L. Bolus, S. Afr. Gard. 19 : 123 (1929).

Gladiolus L. subgenus *Schweiggera* E. Mey. ex Baker, Journ. Linn. Soc. 16 : 178 (1877), Handbk. Irid. 199 (1892) and Fl. Cap. 6 : 138 (1896). *Gladiolus* L. section *Schweiggera* (E. Mey. ex Baker) Benth. & Hook. Gen. Pl. 3 : 710 (1883); Diels in Engl. & Prantl Pflanzenfamilien ed. 2, 15 a : 494 (1930).

Hebea L. Bolus, S. Afr. Gard. 19 ; 123 (1929).

Exohebea Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 36 (1939); Lewis in Adamson & Salter Fl. Cap. Pen. 247 (1950); Phillips Gen. S. Afr. Fl. Pl., ed. 2, 220 (1951).

Tanaosolen N. E. Br., Trans. Roy. Soc. S. Afr. 20 : 262 (1932); Phillips l. c. 220 (1951).

Corm deep-seated, ovoid or subglobose; tunics of matted moderately fine to fairly coarse fibres extending up in a long neck. *Stem* slender or

robust, simple or branched. *Basal leaves* few, sometimes absent at time of flowering, petiolate, the blades erect or suberect, linear, lanceolate or ensiform (in one species more or less oblong and subacute or obtuse), usually firm and coriaceous, fairly prominently 1—7-nerved; *cauline leaves* few, the 1—3 lower short and subulate, the 1—3 upper much reduced and bract-like or minute except in one species. *Spike* lax or compact, with few or many spirally arranged flowers. *Bract* and *bracteoles* alike or nearly so, the latter completely united and as long as the bract or slightly longer, partly or entirely dry at time of flowering, coriaceous and rigid or submembranous and moderately firm, brown or reddish. *Flowers* proterandrous, in one species actinomorphic, in others zygomorphic; *perianth tube* short or long, cylindrical, not or only slightly expanded to the throat; *lobes* unguiculate, subequal or unequal. *Stamens* inserted in throat of perianth tube, well exserted, equilateral in one species, in all others unilateral: anthers dorsifixed, sagittate or linear-sagittate, apiculate. *Ovary* small; style long, with 3 short branches cuneate at the apex or sometimes retuse or very shortly bilobed. *Capsule* ellipsoid or inflated and subglobose; seeds several or many, light, angular, narrowly or fairly broadly winged on the angles.

The type species is *T. leslei* L. Bolus.

The generic name suggests a resemblance in the appearance of the type species to the genus Tritonia.

Key to the Sections.

1. Flowers actinomorphic, the lobes subequal or the outer slightly wider than the inner .. .. 1. *Tritoniopsis*
1. Flowers zygomorphic, the dorsal lobe slightly to distinctly longer than the 3 lower which are shortly connate in a lip 2. *Schweiggera*

Section 1. **Tritoniopsis**

Flowers actinomorphic, the perianth tube about as long as the lobes; lobes subequal or the outer slightly wider than the inner, shortly unguiculate, at first patent, later more or less ascending and forming a wide open cup. Stamens in young flowers erect and symmetrically arranged round the style.

Only species *T. leslei* L. Bolus.

1. **T. leslei** L. Bolus (Fig. 1A), S. Afr. Gard. 19 : 123 (1929).

Corm globose, about 2 cm. diam.; tunics of moderately fine reddish brown fibres with a neck 10—13 cm. long. *Stem* fairly slender, 35—65 cm. high, 1—2 mm. diam. near the base, with 1—2 short or fairly long slender erect branches. *Basal leaves* 3—5, with slender petioles, the blade linear,

13—25 cm. long, 3—5 mm. wide, 1- or 2-nerved; *cauline leaves* 3—5, the lowest arising below ground and like the basal, the 1—3 upper much reduced, brown and bract-like, acuminate, 3—1·5 cm. long. *Spike* laxly 3—10-flowered. *Bract* and *bracteoles* soft and more or less membranous near the apex, becoming fairly firm when dry, reddish to dark reddish brown, lanceolate, acuminate or acute, 1·2—1·6 cm. long, the bracteoles slightly wider and usually slightly longer than the bract. *Flowers* actinomorphic, bright red; *perianth tube* straight, slender, slightly expanded at the throat, 2—2·5 cm. long; *lobes* subequal or the outer a little wider than inner, shortly and fairly broadly unguiculate, obtuse or subacute, at first patent, later more or less ascending and forming a wide open cup, 1·8—2·8 cm. long, the outer oblong or ovate-oblong, 0·7—1·2 cm. wide, the inner oblong or oblong-lanceolate, 7—9 mm. wide. *Stamens* in young flowers erect and symmetrically arranged round the style; filaments 1·6—1·9 cm. long; anthers linear-sagittate, 6—7 mm. long, the apiculus 0·5—1 mm. long. *Ovary* rotund, 2—3 mm. long; style erect, 3—3·5 cm. long, the branches slender, 3—4 mm. long, cuneate at the apex or occasionally retuse or shortly bilobed. *Capsule* ellipsoid, greenish or green and red, 1·2—1·8 cm. long, 0·7—1 cm. diam.; seeds about 5 mm. long, narrowly winged.

Local in marshy ground near streams on lower mountain slopes near Ceres.

TYPE. *Leslie*, N.B.G. 417/27, in the Bolus Herbarium.

Flowering period. February—April.

CERES. Ceres, *Leslie*, N.B.G. 417/27, 246/31 (BOL); marshy ground near stream on lower slopes of Skurweberg, about 5 miles N. of Ceres, *Lewis* 5372 (NBG).

Section 2. **Schweiggera** (E. Mey. ex Baker) Lewis comb. nov.

Gladiolus L. subgenus *Schweiggera* E. Mey. ex Baker, Journ. Linn. Soc. 16 : 178 (1877), Handbk. Irid. 199 (1892) and Fl. Cap. 6 : 138 (1896); *pro sect.* Benth. & Hook. Gen. Pl. 3 : 710 (1883); Diels in Engl. & Prantl Pflanzenfamilien ed. 2, 15 a : 494 (1930).

Flowers zygomorphic, the 3 upper lobes free and 3 lower shortly connate in a lip, sometimes the 2 upper lateral shortly connate with the 3 lower; perianth tube short or long; lobes recurving as the flowers mature, with short or long claws, the dorsal slightly to distinctly longer than the others, at first more or less arcuate, later usually ascending or erect. Stamens unilateral, nearly always arcuate or subarcuate.

The type species is *T. parviflora* (Jacq.) Lewis.

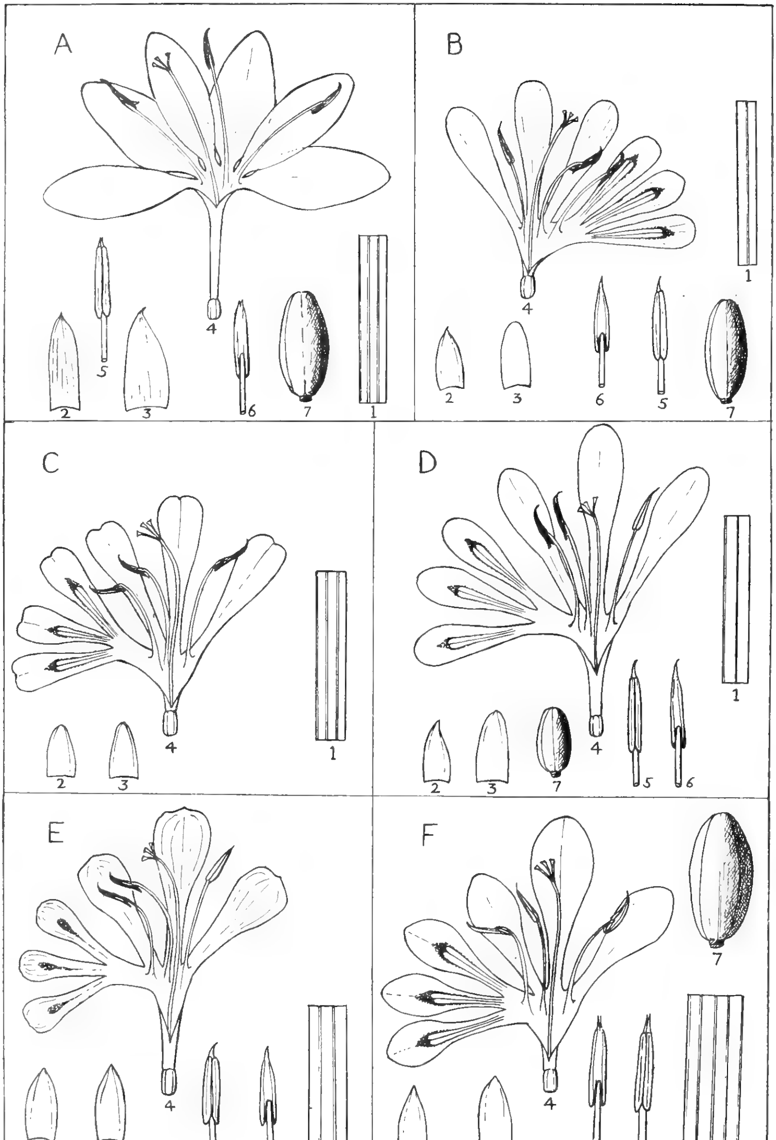

FIG. 1.—A. *T. leslei.* B. *T. ramosa.* C. *T. ramosa*, form. D. *T. ramosa* var. *unguiculata.* E. *T. pulchella.* F. *T. lata.*
1. Part of leaf. 2. Bract. 3. Bracteoles. 4. Flower laid open. 5. Anther and part of filament, front view, × 2. 6. Same, back view, × 2. 7. Capsule.
Del. G. J. Lewis.

KEY TO THE SPECIES.

1. Perianth tube 3 cm. or more long, longer than the lobes.
   2. Bracts not more than 1 cm. long; dorsal perianth lobe less than 1·5 cm. long .. .. 12. *nervosa*
   2. Bracts 2 cm. or more long; dorsal perianth lobe more than 2 cm. long.
      3. Basal leaves oblong or oblong-lanceolate, acute or obtuse, not more than 6 cm. long; upper and lower cauline leaves alike, 4—7 cm. long, the lower part amplexicaul and the upper firmly involute, appearing terete .. .. 13. *flexuosa*
      3. Basal leaves lanceolate or ensiform, acuminate, more than 10 cm. long; upper cauline leaves very much reduced, short and bract-like .. .. 14. *apiculata*

1. Perianth tube usually less than 2 cm. long and shorter than the lobes, occasionally 2—2·8 cm. long and about as long as the dorsal lobe.
   4. Bracts 1·5—2 cm. long; perianth tube 2—2·8 cm. long, about as long as the dorsal lobe.. .. .. .. 14. *apiculata* var. *minor*
   4. Bracts usually less than 1·2 cm. long but occasionally up to 1·6 cm.; perianth tube up to 2 cm. long but usually less, slightly or much shorter than the lobes.
      5. Stem branched.
         6. Basal leaves lanceolate to ensiform, 0·8—2·5 cm. wide, 4—7-nerved, with fairly wide conduplicate petioles.
            7. Stem 1 metre or more high; flowers yellow 6. *nemorosa*
            7. Stem less than half a metre high; flowers pink .. .. 4. *latifolia*
         6. Basal leaves linear to lanceolate, usually 2—8 mm. wide but occasionally up to 1·2 cm., 1—3-nerved (rarely 4), with slender petioles.
            8. Perianth lobes more or less truncate, the 3 upper distinctly wider than the 3 lower .. 3. *pulchella*
            8. Perianth lobes obtuse or occasionally emarginate, the upper lateral and 3 lower equal in width and the dorsal not or only slightly wider .. .. 2. *ramosa* vars.
      5. Stem simple.
         9. Flowers small, 1·2—2·5 cm. long, rarely slightly more but if so then the lobes very narrow and the dorsal with a long claw at least twice as long as the blade; perianth tube 3—5 mm. long.
            10. Flowers 1·2—1·5 cm. long (rarely up to 1·8 cm.), pale yellow or cream-coloured, often with mauve or purplish marks on the lower half of the 3 lower lobes.
               11. Leaves linear, 1—2 mm. wide, 1-nerved; 3 lower perianth lobes cuneate-oblong with very short claws; filaments 3—5 mm. long .. .. 11. *caledonensis*
               11. Leaves linear or linear-lanceolate, 2—7 mm. wide, 2—3-nerved or occasionally with only 1 nerve; 3 lower perianth lobes spathulate or oblong-spathulate with claws nearly as long as the blades; filaments 6—7 mm. long .. .. 10. *unguicularis*
            10. Flowers 1·8—2·5 cm. long.
               12. Perianth lobes very narrow, 2—3 mm. wide or the dorsal occasionally up to 4 mm., the claw of the dorsal at least twice as long as the blade .. .. 7. *parviflora* var. *angusta*

12. Perianth lobes 3 mm. or more wide, the claw of the dorsal less than twice as long as the blade.
- 13. Leaves 2- or 3-nerved; flowers pink .. 9. *dodii*
- *13.* Leaves nearly always 1-nerved; flowers bicoloured, the 3 upper lobes yellow and the tube and lower lobes dark maroon, purplish or purplish red usually with brownish or yellow tips .. .. 7. *parviflora*

9. Flowers 2·5 cm. or more long, the perianth tube 0·6—2 cm. long.
- 14. Perianth lobes more or less truncate; 3 upper lobes nearly equal in width and distinctly wider than the 3 lower .. .. 3. *pulchella*
- *14.* Perianth lobes not as above; upper lateral lobes and 3 lower more or less equal in width.
  - 15. Dorsal perianth lobe usually 7 mm. or more wide, at least 5 mm. longer than the upper lateral lobes and 2 mm. or more wider than the 3 lower .. 5. *lata*
  - *15.* Dorsal perianth lobe rarely more than 6 mm. wide, seldom up to 5 mm. longer than the upper lateral lobes, as wide as the 3 lower or up to 1 mm. wider.
    - 16. Spike very long and many-flowered, slightly or much longer than the non-flowering part of rachis; bracts and bracteoles conspicuously apiculate .. .. 8. *elongata*
    - *16.* Spike not as above; bracts and bracteoles not apiculate or sometimes very shortly and inconspicuously so.
      - 17. Stem usually fairly stout and 2 mm. or more in diam. near the base; bracts obtuse or subacute, firm and coriaceous, rigid when dry; capsule inflated, ovoid or subglobose, about 2·5 cm. long .. .. 9. *dodii*
      - *17.* Stem usually slender and less than 1·5 mm. in diam. near the base; bracts acute, somewhat membranous and soft, sometimes moderately firm but not rigid when dry; capsule ellipsoid, not inflated, up to 1·5 cm. long .. .. 2. *ramosa* vars.

2. **T. ramosa** (Eckl. ex Klatt) Lewis comb. nov.

Antholyza ramosa Eckl. ex Klatt, Linnaea 32 : 734 (1863); Dur. & Schinz Consp. Fl. Afr. 5 : 230 (1895). *Hebea ramosa* Eckl. Top. Verz. 43 (1827), *nomen nudum*; L. Bolus, S. Afr. Gard. 19 : 123 (1929). *Gladiolus montanus* L. f. var. *ramosus* (Klatt) Baker, Journ. Linn. Soc. 16 : 178 (1877) and Fl. Cap. 6 : 164 (1896). *G. ramosus* (Klatt) N. E. Br., Journ. Linn. Soc. 48 : 27 (1928); non L. (1762). *Exohebea ramosa* (Klatt) Foster, ontrib. Gray Herb. Harvard Univ., No. 127 : 39 (1939).

KEY TO THE VARIETIES.

1. Perianth tube up to 1 cm. long but usually less .. .. var. *ramosa*
1. Perianth tube 1·2—2 cm. long.
   2. Leaves up to 5 mm. wide, 1-nerved or occasionally with 2 nerves .. .. var. *unguiculata*
   2. Leaves 0·5—1·2 cm. wide, 2—3-nerved or very occasionally with 4 nerves .. .. var. *robusta*

Var. **ramosa** (Fig. 1 B—C).

Corm ovoid or subglobose, 1·8—3 cm. diam.; tunics dark brown or reddish brown, usually fairly coarse and matted with a thick rope-like neck 8—15 cm. long, sometimes of finer fibres and with a thinner neck. *Stem* slender or fairly slender, 12—50 cm. high, 1—2 mm. diam. near the base, straight or slightly flexuose, nearly always branched, the 1—4 branches slender, sometimes filiform, varying from very short to half as long as the stem and erect to suberect. *Basal leaves* 3—6, sometimes absent or only 1 present at time of flowering, the petioles slender and blades linear to linear-lanceolate, acuminate, 10—25 cm. long, 2—5 mm. wide, 1- or 2-nerved; *cauline leaves* 3—5, usually brown or reddish brown, 4·5—0·5 cm. long, the lower 1—3 subulate and the upper 1 or 2 much reduced and bract-like. *Spike* 5—18 cm. long, laxly 4—18-flowered; lateral spikes shorter, 1—7-flowered. *Bract* and *bracteoles* green at the base, reddish or reddish brown above, soft and more or less membranous, moderately firm when dried, oblong or ovate, 0·5—1 cm. long, acute or obtuse, sometimes very shortly apiculate, sometimes the bract acute and bracteoles obtuse, the latter as long as the bract or 1—2 mm. longer. *Flowers* zygomorphic, faintly sweet-scented, pale pink, mauve-pink or deep magenta-pink, the 3 lower lobes with a crimson or purplish medial line between 2 white lines extending down the claw from near the middle of the blade; *perianth tube* straight or slightly curved, very slightly widened to the throat, 0·7—1 cm. long; *lobes* oblanceolate or oblong-spathulate and obtuse, occasionally cuneate-spathulate and emarginate, the dorsal 2·1—2·8 cm. long, 5—6 mm. wide, the others sub-equal, 2—2·5 cm. long, 4—5 mm. wide, the 3 lower connate for 5—7 mm. *Stamens* arcuate; filaments 1·5—1·8 cm. long; anthers linear-sagittate, 5—7 mm. long, the apiculus acute, recurved, 1—1·5 mm. long. *Ovary* ovoid or oblong, 2·5—3 mm. long; style 2·4—2·8 cm. long, the branches terete, 3—4 mm. long, slightly expanded and cuneate at the apex or occasionally retuse or shortly bilobed. *Capsule* greenish or pallid, ellipsoid, 1·2—1·5 cm. long; seeds 3—4 mm. long, very narrowly winged.

Widespread in hard dry ground or sandy, rocky or marshy slopes on hills and mountains in the south-western districts from Clanwilliam to Swellendam, at altitudes from 700 to 5,000 ft.

LECTOTYPE. *Ecklon* and *Zeyher* 70 in the Herb. Delessert, Geneva.

Flowering period. January—April, occasionally also at other times.

CLANWILLIAM. Sneeuwberg, S. Cedarberg, 5,000 ft., *Esterhuysen* 13822 (BOL); Elands Kloof, near summit, *Smuts* and *Gillett* 3464 (BOL).

PIKETBERG. Mountain above Porterville, along streams, *Loubser* 920 (NBG).

TULBAGH. Twenty-four Rivers Mts., *Zeyher* 3996 (P, SAM); Great Winterhoek Mt., 3,000—3,500 ft., *Galpin* 12580 (PRE); *Compton* 4639 (BOL, NBG); Sneeuwgat, Great Winterhoek, *Phillips* 1869 (SAM); Waboomsrivier, Wolseley, *Stokoe* (No. 58373 in SAM).

CERES. Hexberg, Elands Kloof, *Johnson* 32 (NBG); Elands Kloof, *Barker* 7270 (BOL, NBG); Cold Bokkeveld Mts., Elands Kloof, 3,500—4,000 ft., *Esterhuysen* 18432 (BOL, PRE); Schoongezicht, Cold Bokkeveld Mts., *Stokoe* (No. 65598 in SAM); *Esterhuysen* 21302 (BOL); Skurfdebergen, E. of Citrusdal, *Primos* (SAM); Skurfdeberg, behind Porterville, 3,500 ft., *Edwards* 88 (BOL); Agter Witsenberg, *Lewis* 5360 (NBG); lower mountain slopes near top of Gydo Pass, *Lewis* 5365 (NBG); Skurweberg, about 5 miles N. of Ceres, *Lewis* 5369 (NBG); Michells Pass, *Bond* 334 (NBG); *Lewis* 5359 (NBG).

WORCESTER. Du Toits Kloof, *Drege* 1580 a (G, P, SAM); *Marloth* 632 (PRE); Hex River Valley, near De Doorns, *Bolus* (No. 26640 in BOL); Worcester, *Cooper* 3314 (K); Boschjesveld Mts., near Villiersdorp, *Zinn* (No. 54416 in SAM).

PAARL. French Hoek, foot of mountain, *Smith* 2655 (PRE); Wemmershoek, *Esterhuysen* 18591 (BOL, PRE); Klein Drakenstein Mts., near Salem, *Galpin* (No. 26631 in BOL); Groot Drakenstein, *Rogers* 10504 (BOL); Klapmuts, hill slopes, *Lewis* 5356 (NBG).

STELLENBOSCH. Upper slopes of Stellenbosch Mt., *Galpin* 10605 (PRE); Jonkershoek Valley, *Rycroft* 2149 (NBG).

SOMERSET WEST. Foot of Sir Lowrys Pass, *Stokoe* (No. 65595 in SAM).

CALEDON. Elgin, *Smith* 2536 (PRE); Palmiet River Valley, near Elgin, *Stokoe* (No. 55608 in SAM); Palmiet River, 4 miles W. of Highlands, *Rycroft* 2151 (NBG); Palmiet River Mts., *Stokoe* (No. 59834 in SAM); Sir Lowrys Pass, *Compton* 20466 (NBG); Houwhoek, *Schlechter* 7353 (K, PRE); Viljoens Pass, *Salter* 2998 (BOL, K); *T. Barnard* (No. 26632 in BOL); Boschveld between Donkerhoek and Houwhoek Mts., *Burchell* 8012 (K); between Genadendal and Villiersdorp, *Gillett* 904 (BOL, K); hills near Caledon Baths, *Purcell* 78, 79 (SAM); mountains near Caledon and Genadendal, *Ecklon* and *Zeyher* 70 (G).

ROBERTSON. Klaasvoogds, S. slopes of Langeberg, *Esterhuysen* 22709 (BOL).

SWELLENDAM. Tradouw Pass, *Pole Evans* (No. 26628 in BOL); Swellendam, *Thode* A 2396 (PRE).

WITHOUT LOCALITY. *Bolus* 4069 B (BOL, PRE).

Under the description of *Antholyza ramosa* Klatt cited several collections in the Herb. Reg. Berol. (Berlin-Dahlem Herbarium), but did not designate any particular one as the type. As far as is known they were all destroyed during the last war but isotypes of two or three exist in several herbaria and one of these, *Ecklon* and *Zeyher* 70 in the Delessert Herbarium, has been chosen as the lectotype.

Klatt gave as a synonym *Hebea ramosa* Eckl., which is a *nomen nudum* as there is no description of the plant by Ecklon, but a number of specimens bearing this name were distributed to various herbaria. An examination of some of these has shown that another species, *T. lata*, was confused with it and in the collections in some herbaria specimens of one or the other species under the same name and number have been seen. The differences between the two species are discussed under *T. lata*.

Like most widespread species, *T. ramosa* is very variable. The variety *ramosa* covers a large area and many local forms have been observed, some of which are evidently effected by differences in soil and habitat. For example, plants in marshy ground or near streams on mountain slopes are generally tall, with slender stems and filiform more or less erect branches, whereas those growing in hard dry ground, often in clay or gravel soil, have much coarser corm tunics, shorter and stouter stems and comparatively longer, less slender and more spreading branches.

Var. **unguiculata** (Baker) Lewis comb. nov. (Fig. 1 D).

Tritonia unguiculata Baker Handbk. Irid. 196 (1892) and Fl. Cap. 6 : 128 (1896). *Gladiolus unguiculatus* (Baker) N. E. Br., Journ. Linn. Soc. 48 : 27 (1928); non Baker (1877). *Hebea unguiculata* (Baker) L. Bolus, S. Afr. Gard. 19 : 123 (1929). *Exohebea unguiculata* (Baker) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 39 (1939).

Differs from var. *ramosa* in having slightly smaller corms with fewer and softer tunics and the neck somewhat sparsely fibrous, the branches almost always erect or ascending, the perinth tube longer and capsules and seeds slightly smaller.

Corm ovoid or subglobose, 1·5—2·5 cm. diam.; tunics of fairly fine dark brown or reddish brown fibres, the neck thin, 5—10 cm. long. *Stem* 18—35 cm. high, 1—2 mm. diam. near the base, usually with 1—4 short or fairly long erect or ascending branches. *Basal leaves* 3—4, linear or linear-lanceolate, 10—20 cm. long (usually 10—15 cm.), 2·5—5 mm. wide, 1-nerved or occasionally with 2 nerves. *Spike* 5—12 cm. long, laxly 3—8-flowered. *Bract* and *bracteoles* 0·7—1·2 cm. long, as in var.

ramosa. *Flowers* as in var. *ramosa* but the perianth tube 1·3—2 cm. long. *Capsule* 0·9—1·2 cm. long; seeds 2—3 mm. long, very shortly winged.

Sandy and stony ground on lower mountain slopes from the Caledon to George Divisions.

TYPE. *Kitching*, in Kew Herbarium.

Flowering period. January—March.

CALEDON. Happy Valley, *Barker* 1546 (NBG); Riviersonderend Mts., *Lewis* 2281 (SAM); *Esterhuysen* 25330 (BOL).

SWELLENDAM. Swellendam Mt., *Compton* 10587 (NBG); *Esterhuysen* 4827 (BOL).

HEIDELBERG. Grootvadersbosch, *Esterhuysen* 18248 (BOL).

RIVERSDALE. Garcias Pass, 1,400 ft., *Muir* 3151 (BOL); *Ferguson*, N.B.G. 434/29 (BOL); *Lewis* 5381 (NBG).

MOSSEL BAY. Robinson Pass, *Thorne* (No. 50136 in SAM); *Hops* 18 (BOL).

GEORGE. Postberg, near George, *Burchell* 5949 (K); Cradockberg, 1,500 ft., *Compton* 14386 (NBG).

WITHOUT LOCALITY. *Kitching* (K).

This was previously treated as a separate species, closely allied to *T. ramosa*, but after examining a large amount of material it was found that most of the distinguishing characters listed by N. E. Brown are variable, such as the size of the corm, the length of the internode below the first flower on the branches, and the length of the perianth tube and size of the flowers. In my opinion, the slight and somewhat variable differences do not warrant more than varietal status.

Var. **robusta** Lewis var. nov.

A var. *ramosa* foliis latioribus et perianthii tubo leviter longiore, et a var. *unguiculata* cormo majore, foliis latioribus, bracteis bracteolisque leviter longioribus et capsulis majoribus, distinguitur.

Cormus 2·5—5 cm. diam., tunicis crassis e fibris sat robustis fusce rubido-brunneis in collo 7—14 cm. longo productis, compositis. *Caulis* plerumque 40—50 cm. altus ramis 1—3 gracilibus erectis vel adscendentibus. *Folia basalia* 2—3, plerumque post anthesin evoluta, lanceolata vel ensiformia, 15—28 cm. longa, 0·5—1·2 cm. lata, 2—3-nervata vel raro 4-nervata. *Spica* var. *ramosae* similis. *Bractea* et *bracteolae* lanceolatae, acutae, interdum breviter apiculatae, 0·9—1·5 cm. longae. *Flores* var. *ramosae* similes sed perianthii tubo 1·2—1·5 cm. longo. *Capsula* 1·2—1·8 cm. longa; semina 3—4 mm. longa.

Distinguished from var. *ramosa* by its wider leaves and slightly longer perianth tube and from var. *unguiculata* by its larger corm, wider leaves, slightly longer bracts and bracteoles and larger capsules.

Corm 2·5—5 cm. diam.; tunics thick, of fairly coarse dark reddish brown fibres, the neck 7—14 cm. long. *Stem* usually 40—50 cm. high, with 1—3 slender erect or ascending branches. *Basal leaves* 2—3, usually developed after the flowers, lanceolate or ensiform, 15—30 cm. long, 0·5—1·2 cm. wide, 2—3-nerved or rarely 4—nerved. *Spike* as in var. *ramosa*. *Bract* and *bracteoles* lanceolate, acute, sometimes shortly apiculate, 0·9—1·5 cm. long. *Flowers* as in var. *ramosa* but the perianth tube 1·2—1·5 cm. long. *Capsule* 1·2—1·8 cm. long; seeds 3—4 mm. long.

Sandy and stony ground on lower slopes of the Langeberg in the Swellendam and Heidelberg Divisions.

TYPE. *Lewis* 5447 in the Compton Herbarium, National Botanic Gardens, Kirstenbosch.

Flowering period. January—March.

SWELLENDAM. Ten O'clock Mt., 2,500 ft., *Wurts* 555 (NBG).

HEIDELBERG. Lower southern slopes of Lemoenshoek Peak, *Esterhuysen* 14457 (BOL); Grootvadersbosch, lower slopes of the mountains, *Lewis* 5447 (NBG).

This variety is more robust than the others, especially var. *unguiculata*, with a larger corm and wider leaves. The flowers of all three varieties are very similar, the only difference being in the length of the perianth tube which in var. *robusta* is more or less intermediate between the other two.

3. **T. pulchella** Lewis sp. nov. (Fig. 1 E).

Cormus subglobosus, 1·5—3·5 cm. diam., tunicis e fibris sat robustis rubido-brunneis in collo 6—8 cm. longo productis, compositis. *Caulis* rigidus, rectus vel flexuosus, 20—45 cm. altus, basin versus 2—3 mm. diam., ramis 1—4 brevibus suberectis. *Folia basalia* 5—7, petiolis tenuibus; lamina lanceolata vel lineari-lanceolata, acuminata, 10—18 cm. longa, 3—8 mm. lata, 1—2-nervata (raro 3); *folia caulina* 3—5, 1 vel 2 inferiora basalibus similia sed breviora, 1 vel 2 superiora plerumque brunnea et bracteis similia, 0·5—2·5 cm. longa. *Spica* 5—12 cm. longa, aliquid laxe 8—16-flora. *Bractea* et *bracteolae* brunneae vel rubido-brunneae, firmae, oblongae, acutae vel subacutae, saepe apiculatae, 0·8—1·2 cm. longae, bracteolae quam bracteae leviter longiores. *Flores* irregulares, rosei, laminis segmentorum 3 inferiorum medium versus clare rubri-notatis; *perianthii tubus* rectus, 1·5 cm. longus; *segmenta* cuneato-spathulata, truncata vel subtruncata, dorsale 2·3—2·5 cm. longum, 7—8 mm. latum et lateralia superiora 1·6—2 cm. longa, 6—7 mm. lata; segmenta 3 inferiora aequalia, 1·6—2 cm. longa, 4—5 mm. lata, per 5—7 mm. coalita. *Stamina* arcuata, filamentis 1·7—2·5 cm. longis et

antheris lineari-sagittatis 6—7 mm. longis apiculo acuminato obscure bipartito plus minusve recurvato, 1·5—2 mm. longo, indutis. *Ovarium* oblongo-ovoideum, 3—4 mm. longum; stylus 2·7—3·3 cm. longus, ramis tenuibus apice cuneatis, interdum emarginatis vel breviter bilobatis. *Capsula* et semina non visa.

Corm subglobose, 1·5—3·5 cm. diam.; tunics of fairly coarse reddish brown fibres, the neck 6—8 cm. long. *Stem* rigid, straight or flexuose, 20—45 cm. high, 2—3 mm. diam. near the base, with 1—4 short suberect branches. *Basal leaves* 5—7, with slender petioles, the blade lanceolate or linear-lanceolate, acuminate, 10—18 cm. long, 3—8 mm. wide, 1—2-nerved (rarely 3); *cauline leaves* 3—5, the lower 1 or 2 like the basal but shorter, the upper 1 or 2 usually brown and bract-like, 0·5—2·5 cm. long. *Spike* 5—12 cm. long, somewhat laxly 8—16-flowered. *Bract* and *bracteoles* brown or reddish brown, firm, oblong, acute or subacute, often apiculate, 0·8—1·2 cm. long, the bracteoles slightly longer than bracts. *Flowers* zygomorphic, bright rose-pink, the 3 lower lobes with a bright red mark near the middle of the blade, extending in a medial line down the claw; *perianth tube* straight, 1·5 cm. long; *lobes* cuneate-spathulate, truncate or subtruncate, the dorsal 2·3—2·5 cm. long, 7—8 mm. wide, and upper lateral 1·6—2 cm. long, 6—7 mm. wide; 3 lower lobes alike, 1·6—2 cm. long, 4—5 mm. wide, connate for 5—7 mm. *Stamens* arcuate; filaments 1·7—2·5 cm. long; anthers linear-sagittate, 6—7 mm. long, the apiculus 1·5—2 mm. long, more or less recurved, acuminate, obscurely bipartite. *Ovary* oblong-ovoid, 3—4 mm. long; style 2·7—3·3 cm. long, the branches slender, 4—5 mm. long, cuneate at the apex, sometimes emarginate or shortly bilobed. *Capsule* and seeds not seen.

Stony and sandy soil on mountains, from 1,800 to 3,800 ft.

TYPE. *Compton* 16929 in the Compton Herbarium, National Botanic Gardens, Kirstenbosch.

Flowering period. December—February.

WORCESTER. Bains Kloof, 2,000 ft., *Compton* 16929 (NBG); Baviaans Kloof, off Bains Kloof, 3,000 ft., *Gillett* 803 (K); *Lewis* 5354 (SAM); Du Toits Kloof, *Stokoe* (No. 65599 in SAM); Slanghoek Mts., Observation Peak, 3,500 ft., *Esterhuysen* 8629 (BOL).

WELLINGTON. Witte River Valley, *Esterhuysen* 8684 (BOL).

STELLENBOSCH. Dwarsberg, Jonkershoek, 3,800 ft., *Rycroft* 1256 (SAM); Hottentots Holland Mts., N. of Somerset Sneeuwkop, *Esterhuysen* 9721 (BOL).

CALEDON. South side of Steenbras Dam, on lower slopes below Kogelberg, *Lewis* 4180 (SAM); near Genadendal, 3,500 ft., *Bolus* 7426 (BOL).

In smaller plants there are usually 3—4 leaves and the stem is sometimes not more than 10—15 cm. high and occasionally simple. The species appears to be near *T. lata* and *T. ramosa* but differs from the former in having the stem usually shorter and nearly always branched, the perianth tube longer and the lobes differently shaped, widest almost at the apex, with the two upper lateral lobes almost as wide as the dorsal and distinctly wider than the 3 lower. From *T. ramosa* it differs in its generally more robust habit, the colouring and markings of the flowers and the shape of the perianth lobes. As no fruits of *T. pulchella* have been seen it has not been possible to compare these organs.

Var. **alpina** Lewis var. nov.

A var. *pulchella* caule longiore, ad 65 cm. longo, plerumque simplici, bracteis leviter brevioribus, obtusis, 6—8 mm. longis, et perianthii tubo 1 cm. longo, distinguitur.

Differs from var. *pulchella* in having a longer stem, up to 65 cm. long, usually simple, the bracts slightly shorter and obtuse, 6—8 mm. long, and the perianth tube only 1 cm. long.

TYPE. *Esterhuysen* 13758 in the Bolus Herbarium.

TULBAGH. Among rocks, S. slopes of Little Winterhoek, 6,000 ft., *Esterhuysen* 13758 (BOL).

The altitude is the highest recorded for the genus. This variety, with its taller, usually simple stem, and shorter perianth tube, closely resembles *T. lata* from which it is distinguished mainly by the shape of the perianth lobes.

4. **T. latifolia** Lewis sp. nov.

Cormus subglobosus, circa 4 cm. diam., tunicis e fibris robustis rubidobrunneis in collo compacto rigido cylindrico 12—20 cm. longo productis, compositis. *Caulis* rigidus, rectus vel leviter flexuosus, 12—35 cm. altus, basin versus 1·5—4 mm. diam., plerumque ramis 1—2 brevibus erectis. *Folia basalia* 4—5, disticha, rigida, petiolis sat latis conduplicatis; lamina ensiformia vel lanceolata, acuminata, 8—25 cm. longa (interdum ad 40 cm.), 0·8—2 cm. lata, 4—6-nervata; *folia caulina* 2—4, interdum infimum basalibus simile, cetera linearia, 6—2 cm. longa, 1 vel 2 superiora plerumque brunnea. *Spica* 7—12 cm. longa, laxe 6—12-flora, interdum ad 30 cm. longa et 27-flora. *Bractea* et *bracteolae* rigidae, fusce rubidobrunneae, oblongae, acutae, breviter apiculatae, 0·9—1·2 cm. longae, bracteolae quam bracteae leviter longiores. *Flores* irregulares, rosei, laminis segmentorum 3 inferiorum linea media purpurea notatis; *perianthii tubus* rectus, 0·8—1 cm. longus; *segmenta* spathulata vel oblanceolata, 3—5 mm. lata, obtusa vel interdum plus minusve emarginata, dorsale

2—2·5 cm. longum, cetera subaequalia, 1·7—2 cm. longa, 3 inferiora per 2—5 mm. coalita. *Stamina* arcuata vel suberecta, filamentis 1·2—1·4 cm. longis et antheris lineari-sagittatis 5—5·5 mm. longis, apiculo parvo circa 0·5 mm. longo indutis. *Ovarium* oblongum, 3 mm. longum; stylus 2—2·2 cm. longus ramis tenuibus 2—2·5 mm. longis apice cuneatis. *Capsula* et semina non visa.

Corm subglobose, about 4 cm. diam.; tunics of coarse reddish brown fibres, with a hard compact cylindrical neck 12—20 cm. long. *Stem* rigid, straight or slightly flexuose, 12—35 cm. high, 1·5—4 mm. diam. near the base, usually with 1 or 2 short erect branches, the branches with a very short internode below the first flower. *Basal leaves* 4—5, distichous, rigid, with fairly wide conduplicate petioles, the blade ensiform or lanceolate, acuminate, 8—25 cm. long (occasionally to 40 cm.), 0·8—2 cm. wide, 4—6-nerved; *cauline leaves* 2—4, the lowest sometimes like the basal, the others linear, 6—2 cm. long, the 1 or 2 upper usually brown. *Spike* 7—12 cm. long, laxly 6—12-flowered, sometimes up to 30 cm. long and 27-flowered. *Bract* and *bracteoles* rigid, dark reddish brown, oblong, acute, shortly apiculate, 0·9—1·2 cm. long, the bracteoles slightly longer than bracts. *Flowers* zygomorphic, pink with a dark purplish red medial line on the blades of the 3 lower lobes; *perianth tube* straight, 0·8—1 cm. long; *lobes* spathulate or oblanceolate, 3—5 mm. wide, obtuse or sometimes more or less emarginate, the dorsal 2—2·5 cm. long, the others subequal, 1·7—2 cm. long, the 3 lower connate for 2—5 mm. *Stamens* arcuate or suberect; filaments 1·2—1·4 cm. long; anthers linear-sagittate, 5—5·5 mm. long, the apiculus small, acute or subacute, about 0·5 mm. long. *Ovary* oblong, 3 mm. long; style 2—2·2 cm. long, the branches slender, 2—2·5 mm. long, cuneate at the apex. *Capsule* and seeds not seen.

Rocky mountain slopes in the Clanwilliam Division.

TYPE. *Leipoldt* 3580 in the Bolus Herbarium.

Flowering period. December—January.

CLANWILLIAM. Pakhuis Mt., above 3,500 ft., *Leipoldt* 3580 (BOL); Cedarberg Mts., between Pakhuis and Heuning Vlei, *Esterhuysen* 7432 (BOL).

The wide 4—6-nerved leaves, with fairly broad conduplicate petioles sheathing the base of the stem, are similar to those of *T. nemorosa* but the stem and flowers closely resemble those of *T. ramosa.* Apart from the much wider leaves, it differs from *T. ramosa* in having a stouter stem with shorter and more erect branches which have a very short internode below the first flower, the bracts and bracteoles firmer and more acute, the filaments shorter and the anthers with a smaller apiculus.

PLATE XXXIII. *Tritoniopsis lata* (L. Bolus) Lewis, × approx. 1½.
(Wesselsgat, near Elgin, *Rycroft* 2163.)
Photograph by Prof. H. B. Rycroft.

These same characters, as well as the shape of the perianth lobes, distinguish this species from *T. pulchella*.

5. **T. lata** (L. Bolus) Lewis comb. nov. (Fig. 1 F, Plate xxxiii). *Hebea lata* L. Bolus, Journ. Bot. 68 : 106 (1930). *Exohebea lata* (L. Bolus) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 38 (1939).

Corm subglobose or depressed-globose, 3·5—6 cm. diam.; tunics of densely matted reddish brown fibres, with a thick neck 10—18 cm. long. *Stem* simple (rarely with 1 short erect branch), rigid, 30—70 cm. high, usually 45—60 cm., 2—3·5 mm. diam. near the base. *Basal leaves* 1—3, linear or linear-lanceolate, acuminate, 15—60 cm. long, 3—8 mm. wide, 3-nerved (rarely 4), sometimes brown and dead at time of flowering; *cauline leaves* 3—5, the lower 2 or 3 subulate, 5—1 cm. long, the upper 1 or 2 sometimes 1—2 mm. long and sometimes minute vestigial traces. *Spike* 7—15 cm. long, fairly closely or sometimes somewhat laxly 5—18-flowered. *Bract* and *bracteoles* brown, firm or more or less membranous and fairly soft, oblong or ovate-oblong, acute or subacute, mucronulate, 0·6—1·3 cm. long, equal or the bracteoles up to 3 mm. longer than bracts. *Flowers* zygomorphic, pale or deep pink, the 3 lower lobes with a crimson or magenta spot near the middle of the blade, extending in a medial line—usually between two white lines—down the claw; *perianth tube* straight, 0·6—1·1 cm. long; *lobes* spathulate or occasionally oblong-spathulate, obtuse or sometimes subacute or subtruncate, the dorsal 2·3—3·3 cm. long, 0·7—1·2 cm. wide, the others subequal, 1·8—2·5 cm. long, 5—9 mm. wide, the 3 lower connate for 5—7 mm. *Stamens* arcuate; filaments 1·7—2 cm. long; anthers linear-sagittate, 5—7 mm. long, the apiculus 1—2 mm. long, acuminate, often bipartite and recurved. *Ovary* oblong, about 3 mm. long; style 2·6—2·8 cm. long, the branches 3—4 mm. long, cuneate at the apex, occasionally retuse or shortly bilobed. *Capsule* greenish or pallid, ellipsoid, 2—2·5 cm. long; seeds up to 5 mm. long, fairly broadly winged.

Sandy and rocky places on mountain slopes and plateaux.

Type. *Bolus*, No. 18914 in the Bolus Herbarium.

Flowering period. Usually April—May, sometimes also February—March.

TULBAGH. Witsenberge, near Tulbagh, *Burchell* 8276 (K); Witsenberg Flats, 800 ft., *Marloth* 1729 (PRE).

WORCESTER. Du Toits Kloof, *Loubser* 431 (NBG); Boschjesveld Mts., *Stokoe* (No. 55580 in SAM); 20 miles S. of Worcester, *Andreae* 329 (PRE).

WELLINGTON. Bains Kloof, 700 ft., *Marloth* 12026 (PRE).

PAARL. Top of Drakenstein Mts., near Dal Josaphat, 2,500 ft. *Tyson* 851 (SAM); top of Klein Drakenstein Mts., *Galpin* 10597 (PRE); Emerald Dome, *Esterhuysen* 10076 (BOL); *Stokoe* (No. 57991 in SAM); Berg River Hoek, *Barker* 2963 (NBG); French Hoek, *Bond* 355 (NBG); French Hoek Pass, *Thorns* (NBG); *Lewis* (No. 20309 in BOL); Limietberg, *Esterhuysen* 1597 (BOL); S.W. slopes of Haalhoek Sneeuwkop, 3,000—4,000 ft., *Esterhuysen* 15181 (BOL, NBG, PRE).

STELLENBOSCH. Jonkershoek, *Wasserfall* 96 (NBG); same, 2,500—4,000 ft., *Esterhuysen* 18486 (BOL, PRE); Jonkershoek Twins, 3,000—4,000 ft., *Esterhuysen* 11470 (BOL); Simonsberg, *Drege* 1580 b (P); same, 3,500—4,000 ft., *Esterhuysen* 25460 (BOL); Spitzkop, Banhoek Mts., *Esterhuysen* (No. 28679 in PRE).

SOMERSET WEST. Mountains above Gordons Bay, *Marloth* 4509 (PRE).

CALEDON. Sir Lowrys Pass, *Gill* (No. 52360 in SAM); *Lewis* 138 (SAM); between Sir Lowrys Pass and Elgin, *Barker* 1549 (NBG); Wesselsgat, near Elgin, *Rycroft* 2163 (NBG); Houwhoek Mts., 1,800 ft., *Guthrie* 2318 (BOL); *Bolus* (No. 18914 in BOL); same, 2,500 ft., *Schlechter* 7566 (BOL, PRE); lower slopes of Palmiet River Mts., near Elgin, *Leighton* 420 (BOL); near Rooi Els, *L. Bolus* (No. 23188 in BOL); *Stephens* (No. 14764 in BOL); Paardeberg, above Kleinmond, *Stokoe* (No. 63472 in SAM); Viljoens Pass, *Pillans* (No. 26617 in BOL); Hermanus, *Galpin* 12856 (PRE); Klein River Mts., near Stanford, *Stokoe* (No. 65597 in SAM); slopes of Babylons Tower, Klein River Mts., *Zinn* (No. 53690 in SAM); Shaws Mt., *T. Barnard* (No. 26617 in BOL); near top of Shaws Pass, S. side, *Lewis* 2242 (SAM); *Barker* 6125 (NBG); foothills of Riviersonderend Mts., *Lewis* 2279 (SAM); mountains near Caledon and Genadendal, *Ecklon* and *Zeyher* 70 (56.5), partly (SAM); mountains at Grietjesgat, between Sir Lowrys Pass and Palmiet River, 2,000—4,000 ft., *Ecklon* and *Zeyher* 56.6 (PRE).

This fairly common and widespread species was confused with *T. ramosa* by Ecklon and Zeyher, Klatt and others, and some of the specimens I have seen which were distributed under the same number by Ecklon and Zeyher, as *Hebea ramosa* Eckl., are *Tritoniopsis ramosa*, while others are *T. lata*. The corm of this species is larger than that of *T. ramosa* and the whole plant is more robust, with a taller stem which is very rarely branched—of the many specimens examined only two with one very short branch each have been seen—the spike usually with more numerous closely arranged flowers, and the flowers themselves slightly larger with the dorsal perianth lobe wider. In *T. ramosa* all the lobes are fairly narrow and more or less equal in width, or the dorsal is some-

times up to 1 mm. wider than the others, whereas in *T. lata* it is 2—3 mm. wider than the 3 lower lobes.

In Contributions from Gray Herbarium of Harvard University No. 127, p. 38 (1939), Foster published the following note under this species: "To the synonymy of this species and its variety, I suspect that two more names should be added. In 1937, Grey, Hardy Bulbs 1 : 163–64, mentioned and briefly described a *Hebea alata*, which he ascribed to (L.) L. Bol., based on *Gladiolus alatus* L., and *H. alata* var. *longibracteata* L. Bol. I have been unable to find that Mrs. Bolus made such a new combination, and the only variety *longibracteata* which I have found in *Hebea* is that described by Mrs. Bolus under *H. lata*. Probably there has been a confusion, based on the similarity of the name, between *G. alatus* and *Hebea lata*".

Var. **longibracteata** (L. Bolus) Lewis comb. nov.

Hebea lata L. Bolus var. *longibracteata* L. Bolus, Journ. Bot. 68 : 107 (1930). *Exohebea lata* var. *longibracteata* (L. Bolus) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 38 (1939).

Spike, *bracts* and *bracteoles* usually longer than in var. *lata*, and *perianth lobes* slightly narrower; *spike* up to 24 cm. long and 24-flowered; *bract* and *bracteoles* up to 1·6 cm. long; dorsal perianth lobe 5—8 mm. wide, the others 4—6 mm. wide.

Rocky mountain slopes in the Wellington, Worcester and Ceres Divisions.

Type. *Bolus* 4069 in the Bolus Herbarium.

Flowering period. March.

WELLINGTON. Among Restionaceae on southern slopes of Drakensteinberg, near Bains Kloof, 1,600 ft., *Bolus* 4069 (BOL).

WORCESTER. Bains Kloof, *Barker* 7264 (NBG); *Galpin* 12626 (PRE); same, rocky W. slopes, 2,000—3,000 ft., *Esterhuysen* 25622 (BOL); Baileys Peak, Bains Kloof, eastern slopes, 3,000 ft., *Esterhuysen* 22749 (BOL); Du Toits Kloof, S.E. slopes of Molenaarsberg, *Esterhuysen* 17249 (BOL); same, stony slopes and plateau, 3,000 ft., *Esterhuysen* 22776 (BOL).

CERES. Michells Pass, *L. Bolus* (No. 26620 in BOL).

The type specimen is exceptionally tall with a longer spike than usual, and a short erect abortive branch near the middle of the stem. Other plants collected in the vicinity closely resemble the var. *lata* but have slightly longer bracts and bracteoles.

6. **T. nemorosa** (E. Mey. ex Klatt) Lewis comb. nov. (Fig. 2 A). *Antholyza nemorosa* E. Mey. ex Klatt Erganz. 12 (1882); Dur. & Schinz Consp.

Fl. Afr. 5 : 229 (1895). *Schweiggera nemorosa* E. Mey., Flora ii, Besond. Beigab. 109 (1843), *nomen nudum. Gladiolus nemorosus* (Klatt) Baker Handbk. Irid. 226 (1892); N. E. Br., Journ. Linn. Soc. 48 : 27 (1928). *G. montanus* (L. f.) var. *nemorosus* (Klatt) Baker, Fl. Cap. 6 : 164 (1896). *Hebea nemorosa* (Klatt) L. Bolus, S. Afr. Gard. 19 : 123 (1929). *Exohebea nemorosa* (Klatt) Foster, Contrib. Gray Herb., Harvard Univ., No. 127: 38 (1939).

Corm not seen, 20 cm. or more below ground, the neck 20 cm. or more long, of coarse reddish brown fibres. *Stem* stout, about 1—1·5 m. high, 5—8 mm. diam. near the base, usually with 2—3 suberect branches. *Basal leaves* 5—7, distichous, firm or rigid, the petioles wide and conduplicate, the blades lanceolate or ensiform, acuminate, 15—35 cm. long, 0·9—2·5 cm. wide, 5—7-nerved; *cauline leaves* 3—5, the lower 1 or 2 similar to the basal but much shorter and narrower, the upper 2 or 3 linear, acuminate, 5·5—1·5 cm. long. *Spike* 25—35 cm. long, laxly many-flowered. *Bract* and *bracteoles* firm, brown or greenish brown, oblong or ovate-oblong, obtuse or acute, 6—9 mm. long, the bracteoles slightly longer than bracts. *Flowers* zygomorphic, bright yellow, usually with a dark purplish maroon median line on the 3 lower lobes; *perianth tube* 7—8 mm. long, straight, slightly expanded at the throat; *lobes* oblong-spathulate, truncate or obtuse, the dorsal 2·5 cm. long, 7—8 mm. wide, the others 1·8—2 cm. long, 5—6 mm. wide, the 3 lower connate for 4 mm. *Stamens* suberect; filaments 1·2—1·5 cm. long; anthers linear-sagittate, 7—9 mm. long, the apiculus short and more or less bifid. *Ovary* rotund, about 3 mm. long; style 2—2·3 cm. long, the branches filiform, slightly flattened and cuneate at the apex, occasionally retuse or bifid. *Capsule* large and inflated, reddish brown, ovoid or globose, about 3 cm. long; seeds up to 8 mm. long.

Confined to the Clanwilliam Division, in stony ground or among rocks on the lower slopes of mountains.

LECTOTYPE. *Drege* 1578 in the Herbarium of the National Natural History Museum, Paris.

Flowering period. November—December.

CLANWILLIAM. Olifants River Valley, *Drege* 1578 (P); between Lange Vallei and Olifants River, 1,000—1,500 ft., *Drege* (K); Olifants River Valley, 17—18 miles N. of Citrusdal, *T. Barnard* (No. 68437 in SAM); Elands Kloof, *Stokoe* (No. 55596 in SAM); near Elands Kloof, *Mathews*, N.B.G. 2088/29 (BOL, K); Cedarberg, *Salter* (No. 26636 in BOL); *Thode* A 2183 (PRE); upper southern slopes above Kradouw Krantz, *Pearson* 5305 (BOL); Nieuwoudt Pass, *Bond* 1321 (NBG); *Salter* 5063 (BOL, PRE, SAM); *Esterhuysen* 7159, 17965 (BOL).

As the type in the Berlin-Dahlem Herbarium is missing and presumably destroyed, an isotype in the Natural History Museum Herbarium in Paris has been selected as the lectotype. It is possible that Drege's specimens in Kew Herbarium might also be an isotype but there

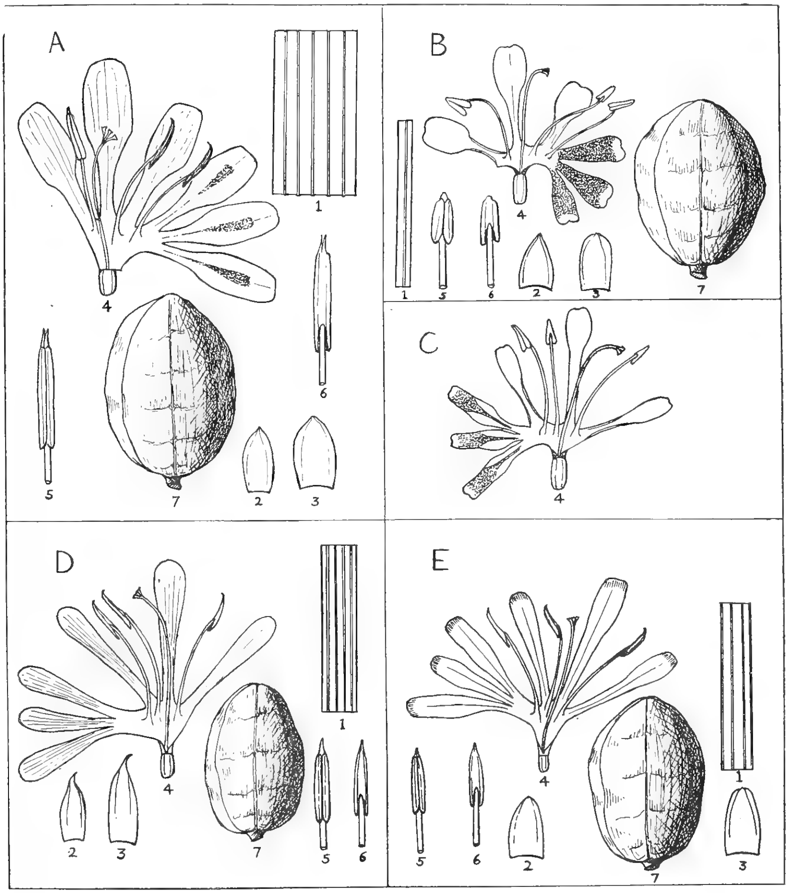

Fig. 2.—A. *T. nemorosa*. B. *T. parviflora*. C. *T. parviflora* var. *angusta*. D. *T. elongata*. E. *T. dodii*.
1. Part of leaf. 2. Bract. 3. Bracteoles. 4. Flower laid open. 5. Anther and part of filament, front view, × 2. 6. Same, back view, × 2. 7. Capsule. *Del.* G. J. Lewis.

is no number on Drege's label. The species is the tallest and most robust in the genus and is readily distinguished by the height of the stem, with its long spike and yellow flowers.

7. **T. parviflora** (Jacq.) Lewis comb. nov. (Fig. 2 B). *Gladiolus parviflorus* Jacq. Obs. 4 : 2, t. 78 (1771); Willd. Sp. Pl. 1 : 208 (1798). *Hebea parviflora* (Jacq.) L. Bolus, S. Afr. Gard. 19 : 123 (1929). *Exohebea parviflora* (Jacq.) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 38 (1939); Lewis in Adamson & Salter Fl. Cap. Pen. 247 (1950). *Gladiolus montanus* L. f. Suppl. 95 (1781); Willd. l. c. 1 : 208. *Antholyza montana* (L. f.) Ker in Konig & Sims Ann. Bot. 1 : 233 (1805); Lodd. Bot. Cab. 11, t. 1022 (1825); Dur. & Schinz Consp. Fl. Afr. 5 : 229 (1895). *Gladiolus tabularis* Pers. Syn. 1 : 44 (1805), pro parte. *Hebea orchidiflora* (Andr.) Eckl. Top. Verz. 43 (1827), as to plant. *Antholyza orchidiflora* (Andr.) Klatt, Linnaea 32 : 733 (1863), as to plant; Dur. & Schinz l. c. 229. *Gladiolus arenarius* Baker, Journ. Linn. Soc. 16 : 178 (1877); Handbk. Irid. 226 (1892) and Fl. Cap. 6 : 163 (1896), pro parte. *Hebea arenaria* (Baker) L. Bolus, S. Afr. Gard. 19 : 123, pro parte. *Antholyza fragrans* E. Mey. ex Klatt Erganz. 13 (1882). *Schweiggera montana* E. Mey. in Herb. Drege.

Corm ovoid or subglobose, 2—3 cm. diam.; tunics of coarse wiry dark reddish brown fibres, the neck usually thick, hard, compact and cylindrical, 7—13 cm. long. *Stem* rigid, simple, curved just above the neck, 15—40 cm. high (usually 18—25 cm.), 1·5—3 mm. diam. near the base. *Basal leaves* 5—7, with slender petioles usually extending shortly above ground, the blades firm, linear or subulate, acuminate, 8—22 cm. long, 2—5 mm. wide, 1-nerved or occasionally with 2; *cauline leaves* 2 or 3, very much reduced, the lowest usually subulate and 1—3 cm. long, the upper 1 or 2 minute. *Spike* 3—12 cm. long, usually closely 8—20-flowered. *Bract* and *bracteoles* rigid, green at the base and brown above, ovate or oblong, obtuse, the former 5—8 mm. long and the latter 6—9 mm. *Flowers* zygomorphic, with a sweet spicy scent which persists for many years after drying, the 3 upper lobes pale to bright yellow, the tube and 3 lower lobes deep maroon, purple or occasionally purplish red, with the lower half of the blade sometimes more or less translucent and the apex often yellowish at first but soon becoming brown; *perianth tube* 3—4 mm. long; *lobes* retuse or emarginate, the 3 upper spathulate with slightly undulate blades and 3 lower distinctly undulate, cuneately oblong-spathulate or the blades sometimes panduriform with wide translucent margins in the lower half and slightly wider near the base than the apex; dorsal lobe 1·4—1·7 cm. long, 4—6 mm. wide near the apex, with a narrow claw as long as the blade or slightly longer; upper lateral lobes

1—1·4 cm. long, 3·5—5 mm. wide, with canaliculate claws as long as the blade or slightly shorter, connate with the 3 lower lobes for about 1 mm. then curved up and back towards the dorsal; 3 lower lobes alike, 1—1·3 cm. long, 3—4 mm. wide, the claws shorter than the blades, connate for 3—4 mm. *Stamens* yellow, arcuate; filaments 1·2—1·4 cm. long; anthers sagittate, 3—4 mm. long, the apiculus very short and obtuse or acute or sometimes wanting. *Ovary* oblong, 4—5 mm. long; style about 1·5 cm. long, the branches cuneate, about 1 mm. long. *Capsule* large and inflated, pale reddish brown, subglobose, 2·4—3·4 cm. long; seeds up to 9 mm. long.

Sandy ground among rocks on mountains and flats near the foot of mountains.

TYPE. Jacquin Obs. 4, t. 78.

Flowering period. November—January.

CLANWILLIAM. Olifants River Valley, Brakfontein, *Ecklon* and *Zeyher* 76 (PRE).

MALMESBURY. Riebekskasteel, 1,000 ft., *Drege* (No. 48507 in SAM).

TULBAGH. Near Tulbagh Waterfall, 800 ft., *Bolus* (No. 26624 in BOL); De Hoek Estate, near Saron, *Lewis* (No. 26623 in BOL); Saron, in mountains, 2,000 ft., *M. Schlechter* 1735 (PRE); Tulbagh, *Ecklon* 72 (SAM).

WORCESTER. Du Toits Kloof, 2,000—4,000 ft., *Drege* (K, P); *Esterhuysen* 22304 (BOL); Worcester, near Waterfall, *Ecklon* 71 (SAM); Stettynsberg, 3,000—4,000 ft., *Esterhuysen* 11059 a (BOL, PRE).

WELLINGTON. Witte River Valley, *Thorne* (No. 46517 in SAM); Bains Kloof, *Grant* 2642 (BOL, PRE).

PAARL. French Hoek Pass, 3,000 ft., *Compton* 8181 (NBG); *Taylor* 1483 (PRE); French Hoek, 900 ft., *Phillips* 1322 (SAM); Haalhoek Sneeuwkop, 3,000—4,000 ft., *Esterhuysen* 9679 a (BOL); *Stokoe* (No. 56444 in SAM); Slanghoek Mts., Witteberg, 3,000—4,000 ft., *Wasserfall* 629 (NBG).

STELLENBOSCH. Banhoek, *Martley* 4 (BOL); Jonkershoek, *Compton* 15287 (BOL, NBG); near Stellenbosch, *Worsdell* (K).

CAPE. Cape Peninsula, *Ecklon* 10 (G, K, PRE); top of Table Mt., *Pappe* (No. 21446 in SAM); slopes N. of Window Stream, Kirstenbosch, *Esterhuysen* 17822 (BOL); Orange Kloof, *Salter* 9737 (BOL); Cape Flats, near Rondebosch, *Bolus* 3837 (BOL, PRE); Flats near Claremont Sanatorium, *Dod* 484 (BOL, K); Retreat Flats, *Dod* 3608 (BOL); Steenberg Plateau, *Lewis* 799 (SAM); *Salter* 2959 (BOL); Muizenberg Mt., *Andreae* 125 (PRE); *Salter* 1881 (K); *Moss* 8145 (PRE); mountains between Muizenberg and Silvermine, *Andreae* 125 (PRE); Silvermine Valley,

Esterhuysen 1767 (BOL); Chapmans Peak, 700 ft., *Wasserfall* 702 (NBG); Smitswinkel, *Middlemost* 1675 (NBG); Rooihoogte, near Smitswinkel, *Compton* 15503 (NBG); *Galpin* 12735 (PRE); Cirkels Vlei, *Salter* (No. 26621 in BOL); Cape Point Reserve, *Leighton* 382 (PRE).

SOMERSET WEST. Foot of Sir Lowrys Pass, *Lewis* 5350 (NBG).

CALEDON. Sir Lowrys Pass, *Drege* (P); *Ryder* 118 (K); Houwhoek, *Zeyher* (No. 48503 in SAM); *Lewis* 5316 (NBG); *Maguire* 1242 (NBG); *Galpin* 4725 (PRE); Highlands, *Compton* 14079 (NBG); Elgin, *Lewis* 984 (SAM); Viljoens Pass, *Salter* 4022 (BOL); Nuberg, near top of Viljoens Pass, *Stokoe* (No. 68322 in SAM); near Villiersdorp, *Barker* 311 (NBG); Palmiet River, *Compton* 14137 (NBG); *Barker* 1560 (NBG); *Pillans* 8503 (BOL); Palmiet River Mts., *Stokoe* (No. 60129 in SAM); Arieskraal, *Leighton* 805 (BOL); Riviersonderend, *Van Niekerk* 687 (BOL).

BREDASDORP. Baardscheerdersbosch, between Elim and Gansbaai, *Stokoe* (No. 59835 in SAM); Bredasdorp, *Du Toit*, N.B.G. 2408/29 (BOL); same, mountain top, *Galpin* (No. 26625 in BOL, No. 11299 in PRE, K); Gunners Quoin, *Long* 1 (BOL); Rietfontein, *Smith* 5057 (PRE).

WITHOUT LOCALITY. *Thunberg* (named *Gladiolus trinervis* in Herb. Thunb., UPS); *Masson* (G); *Drege* (G); *Krook* (K); *Sparrman* 162 (type of *Gladiolus montanus* L. f., LINN); *Zeyher* 1612 (locality incorrectly given as Bushmans River Mouth, G, K, SAM).

In the South African Museum Herbarium there are some specimens of *T. unguicularis* under Zeyher's number 1612, collected by him on the top of Table Mt., and under the same number specimens of *T. parviflora* for which the locality is given as Bushmans River Mouth. There has obviously been some confusion and it is very possible that both species were collected by Zeyher on Table Mt. The most easterly record for the genus is the George Division, and for *T. parviflora* the Bredasdorp Division.

As detailed accounts of the confusion about this species have been given by N. E. Brown (Journ. Linn. Soc. 48 : 26 (1928)) and Foster (Contrib. Gray Herb. No. 127 : 38 (1939)), it is not necessary to repeat all the particulars here. It was pointed out by Dr. Brown that in the Flora Capensis (6 : 163) Baker included two species under *Gladiolus arenarius* (a new name given by him when he transferred *Antholyza orchidiflora* to Gladiolus), one being *Gladiolus parviflorus* Jacq. and the other a species which Brown presumed to be new and named *G. fraternus* (= *Tritoniopsis unguicularis* (Lam.) Lewis). *G. montanus* L. f. is a synonym of *G. parviflorus* Jacq., but as defined by Baker in the Flora Capensis, *G. montanus* is a mixture of two or three species which are quite distinct from *G. parviflorus* Jacq.

On the type sheet of *G. montanus* in the Linnaean Herbarium (59.24) there is a complete specimen of *Tritoniopsis parviflora* on the left (*Sparrman* 162, the type of *Gladiolus montanus*), and on the right are two inflorescences of *T. unguicularis*. The latter are possibly a later addition and might perhaps have been received from Thunberg. In Thunberg's herbarium there is one sheet of *T. parviflora*, named *Gladiolus trinervis* by Thunberg (an unpublished name), and one sheet which he named *G. montanus*. According to N. E. Brown this second sheet equals *G. montanus* L. f., but when I examined the Iridaceae in Thunberg's herbarium in Uppsala in 1949, I noted that it was the same as *G. fraternus* N. E. Br., i.e. *Tritoniopsis unguicularis*, and matched the two right-hand spikes on sheet 59.24 in the Linnaean Herbarium, but not *Sparrman* 162.

Thunberg's description of *Gladiolus montanus* seems to have been drawn from the specimens of *Tritoniopsis unguicularis* rather than *T. parviflora*, e.g. he described the leaves as 3-nerved, which is correct for the former but not the latter species. Both occur on top of Table Mt., the locality given by Thunberg, but he gave the flowering months as February, March, April, which is too late for *T. parviflora*. His description of the flowers—"corollae limbus ringente-bilabiatus; labium superius tripartitum macula purpurea; inferius profundus tripartitum"—is puzzling, as the lower and not the upper lip is marked with purple in both species, in *T. unguicularis* the markings, when present, being fairly pale and not very conspicuous, while in *T. parviflora* the 3 lower lobes are almost entirely purple or deep maroon. An examination of Thunberg's figure would probably clarify this point and make it possible to decide which of the two species he actually described, but unfortunately the figure is missing from the only copy of his *Dissertationes* available here and I have not seen it. For the present *Gladiolus montanus* Thunb. (not L. f.) is placed in the synonymy under *Tritoniopsis unguicularis*, with a query.

Var. **angusta** (L. Bolus) Lewis comb. nov. (Fig. 2 C). *Hebea angusta* L. Bolus, Journ. Bot. 68 : 106 (1930). *Exohebea angusta* (L. Bolus) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 36 (1939).

Differs from var. *parviflora* in having a slightly longer and laxer spike, slightly larger flowers with narrower perianth lobes and the dorsal lobe with a longer claw, at least twice as long as the blade.

Corm, stem, leaves and *bracts* as in var. *parviflora*. *Spike* 6—18 cm. long, laxly 7—21-flowered. *Flowers* dull yellow with the 3 lower lobes and sometimes also the 3 upper more or less brownish, dull purple or reddish, the claws of the 3 upper with narrow hyaline margins and

blades of the 3 lower with wide hyaline margins; *perianth tube* 4—5 mm. long; *lobes* obtuse, truncate or emarginate, 2—3 mm. wide, the dorsal 1·5—2 cm. long, occasionally up to 4 mm. wide, with the claw twice as long as the blade or more; upper lateral lobes 1·3—1·5 cm. long, the claw as long as the blade or slightly longer, connate with the lower lobes for about 2 mm.; 3 lower lobes 1·3—1·5 cm. long, connate for about 4 mm., the claws slightly shorter than the somewhat panduriform blades. *Stamens* with filaments 1·5—1·9 cm. long, otherwise as in var. *parviflora*. *Gynaecium*, *capsule* and *seeds* as in var. *parviflora*.

Sandy ground on or at the foot of mountains in the Piketberg, Ceres and Caledon Divisions.

TYPE. *Bolus* 7455 in the Bolus Herbarium.

Flowering period. December.

PIKETBERG. Twenty-four River Mts., above Porterville, *Esterhuysen* 16617 (BOL, NBG).

CERES. Foot of mountains near Ceres, *Bolus* 7455, 9650 (BOL); Skurfdeberg and Twenty-four River Mts., *Zeyher* (No. 54275 in SAM); Elands Kloof, *Lewis* 841 (SAM): *Bond* 709 (NBG); same, 3,200 ft., *Compton* 16781 (NBG).

CALEDON. Near Hermanus, *Bolus* (No. 26642 in BOL); Hermanus, *T. Barnard* (No. 26643 in BOL); *Lewis* 5348 (NBG).

In the thirty years since Dr. L. Bolus established this as a separate species, more material has been collected which now connects it so closely with *T. parviflora* that it cannot be regarded as more than a variety. The widespread var. *parviflora* is very variable and one or two of the forms which have been placed in it are more or less intermediate between the two varieties, i.e. *Grant* 2642 from Bains Kloof, and *Salter* (BOL 26621) from Cirkels Vlei, Cape Peninsula.

Hybrids between *T. parviflora* var. *angusta* and *T. dodii* have been recorded from the foot of mountains at Hermanus (*Lewis* 5349), where both parents were found flowering together at the same time, the latter just starting to flower and the former nearly over.

8. **T. elongata** (L. Bolus) Lewis comb. nov. (Fig. 2 D). *Hebea elongata* L. Bolus, Journ. Bot. 68 : 106 (1930). *Exohebea elongata* (L. Bolus) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 37 (1939).

Corm subglobose, 2·5—3·5 cm. diam.; tunics very dark reddish brown, with a hard compact cylindrical neck 15—25 cm. long. *Stem* simple, 38—60 cm. high, 2·5—3 mm. diam. near the base. *Basal leaves* brown and dead at time of flowering or sometimes 1 immature leaf present, linear-lanceolate, acuminate, 22 cm. or more long, 4—6 mm. wide, closely 3—4-nerved; *cauline leaves* wanting or sometimes 1—3

very reduced or minute scale-like vestigial traces. *Spike* 20—40 cm. long, laxly 12—38-flowered, straight or flexuose. *Bract* and *bracteoles* oblong or ovate-oblong, apiculate, 0·7—1·3 cm. long, brown and firm with brownish or colourless scariose margins, those of the bract very narrow and of the bracteoles fairly wide, the latter 1—2 mm. longer than the bracts. *Flowers* zygomorphic, dull dingy pink with dark reddish veins on the lobes; *perianth tube* 6—8 mm. long, straight, slightly expanded at the throat; *lobes* long unguiculate, oblanceolate, obtuse, 3—4 mm. wide, the dorsal 2—2·5 cm. long, the others subequal, 1·5—1·8 cm. long, the 3 lower connate for 4—5 mm. *Stamens* arcuate or subarcuate; filaments 1·3—1·6 cm. long; anthers linear-sagittate, 6—7 mm. long, the apiculus acute, about 1 mm. long. *Ovary* rotund, 2—3·5 mm. long; style 1·8—2·3 cm. long, the branches filiform, about 3 mm. long, slightly expanded and cuneate at the apex, occasionally retuse or very shortly bipartite. *Capsule* reddish brown, inflated, subglobose, 2·5—3·5 cm. long; seeds up to 1 cm. long, fairly broadly winged.

In hard clay and gravel soil on flats and low hill slopes in the Paarl Division.

TYPE. *Tyson* 853 in the South African Museum Herbarium, National Botanic Gardens, Kirstenbosch.

Flowering period. March—April.

PAARL. Dal Josaphat, on hills, 600 ft., *Tyson* 853 (SAM); *Lewis* 5357 (NBG); Berg River, between Paarl and Pont, 500 ft., *Drege* 1579 (P); Klapmuts, *T. Barnard* (No. 20697 in BOL).

The very elongated spike, conspicuously apiculate bract and bracteoles and dingy pinkish flowers distinguish this species, which appears to be fairly rare. Klatt cited *Drege* 1579 under *Antholyza ramosa* (= *Tritoniopsis ramosa*), but the specimen in the Berlin-Dahlem Herbarium which he must have seen has presumably been destroyed with the rest of the material of this genus. I have seen an isotype in the Herbarium of the Natural History Museum in Paris and identified it as *T. elongata*. Drege's locality, in the Paarl Division, is near the type locality of this species.

9. **T. dodii** (Lewis) Lewis comb. nov. (Fig. 2 E). *Hebea dodii* Lewis, Fl. Pl. of S. Afr. 14 : p. 549 (1934). *Exohebea dodii* (Lewis) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 37 (1939); Lewis in Adamson & Salter Fl. Cap. Pen. 247 (1950).

Corm subglobose, 3—5 cm. diam.; tunics thick, of dark reddish brown wiry fibres, with a thick neck 10—20 cm. long. *Stem* simple, 20—55 cm. high, usually 40—50 cm., 2—2·5 mm. diam. near the base. *Basal leaves* 1—3, with slender petioles, the blades linear, tapering to base and apex,

15—35 cm. long, usually 3·5—5·5 mm. wide but occasionally up to 8 mm., firm, 2- or sometimes 3-nerved; *cauline leaves* 3—5, the lowest linear, acuminate, 3—6 cm. long, usually arising well below ground and more or less concealed within the neck, the upper 2—4 minute and scale-like. *Spike* 5—12 cm. long, laxly to fairly closely 8—22-flowered, usually 6—8 cm. long and 10—16-flowered. *Bract* and *bracteoles* dark brown or reddish brown, firm, coriaceous (rigid when dry), ovate or oblong, acute, subacute or obtuse, 0·7—1·1 cm. long, the bracteoles as long as the bract or slightly longer. *Flowers* zygomorphic, pale to deep pink, the lobes sometimes tipped with crimson and the 3 lower usually with a crimson mark or line near the middle; *perianth tube* straight or slightly curved, 5—8 mm. long, slightly expanded at the throat; *lobes* obtuse, truncate or occasionally emarginate, the 3 upper spathulate or oblong-spathulate, 3—5 mm. wide near the apex, the dorsal 2—2·3 cm. long and lateral 1·6—1·9 cm. long; 3 lower lobes like the upper or sometimes oblanceolate, 3—5 mm. wide, 1·6—1·9 cm. long, connate for 3—5 mm. *Stamens* arcuate; filaments 1·2—1·4 cm. long; anthers linear-sagittate, 4—6 mm. long, the apiculus subobtuse or acute and bifid, 0·5—1 mm. long. *Ovary* oblong or rotund, 2·5—3 mm. long; style 2 cm. long, the branches cuneate, 1·5—2 mm. long. *Capsule* large and inflated, ovoid or subglobose, about 2·5 cm. long, with fairly large widely winged seeds.

Rocky hills and mountain slopes near the coast in the southern parts of the Cape Peninsula, the Caledon and Bredasdorp Divisions.

TYPE. *Salter* 2986 in the Bolus Herbarium.

Flowering period. Usually February—April, but found also at various times throughout the year.

CAPE. Simonsberg, *Dod* 806 (BOL); hills W. of Simonstown, *Dod* 1016 (BOL); lower E. slopes of Groot Kop, Simonstown, *Leighton* 1644 (BOL); Simonstown Mts., *Dummer* 1271 (SAM); *Minicki* (Nos. 51396, 52014 in SAM); *Marloth* 599 (PRE); between Witsands and Redhill, *Lewis* 4806 (SAM); *Gillett* 1517 (BOL); near Smitswinkel, 1,300 ft., *Compton* 8707 (NBG); Cirkels Vlei, *Salter* 2986 (BOL, SAM); Klaver Valley, *Lewis* 110 (SAM); Schusterskraal, *Barker* 4004 (BOL, NBG); Bonteberg, *Barker* 814 (NBG); W. of Paulsberg, *Salter* 5763 (PRE); Olifantsbosch, *Galpin* 12734 (PRE).

CALEDON. Klein River Mts., *Stokoe* (Nos. 68323, 69590 in SAM); flats and lower mountain slopes, Hermanus, *T. Barnard* (No. 26641 in BOL); *Leighton* 359 (BOL); *Lewis* 5347 (NBG); top of Shaws Pass, *Davis* (No. 60707 in SAM).

BREDASDORP. The Poort, between Bredasdorp and Elim, *L. Bolus* (No. 26638 in BOL).

WITHOUT LOCALITY. *Elliot* 33 (G).

This species is nearest to *T. unguicularis*, with which it has sometimes been confused in the past, but the flowers are of a different colour and larger, with comparatively longer and narrower perianth lobes. In appearance it somewhat resembles *T. lata* but the flowers are smaller, with narrower lobes, and the capsule is much larger, inflated and ovoid or subglobose, instead of ellipsoid. It also resembles *T. elongata* but has a shorter spike and the bracts and bracteoles are not apiculate.

10. **T. unguicularis** (Lam.) Lewis comb. nov. (Fig. 3 A). *Moraea unguicularis* Lam. Illus. Gen. No. 490 (1791); Encyc. 4 : 274 (1797). *Vieusseuxia unguicularis* (Lam.) Roem. & Schult. Syst. 1 : 491 (1817), pro parte, excl. syn. *Exohebea unguicularis* (Lam.) Lewis, Ann. S. Afr. Mus. 40 : 132 (1954). *Gladiolus arenarius* Baker, Handbk. Irid. 226 (1892) and Fl. Cap. 6 : 163 (1896), pro parte. *Hebea arenaria* (Baker) L. Bolus, S. Afr. Gard. 19 : 123 (1929), pro parte. *Gladiolus fraternus* N. E. Br., Journ. Linn. Soc. 48 : 26 (1928). *Exohebea fraterna* (N. E. Br.) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 37 (1939); Lewis in Adamson & Salter Fl. Cap. Pen. 247 (1950). *Gladiolus tabularis* Pers. Syn. 1 : 44 (1805), pro parte. ? *G. montanus* Thunb. Diss. Glad. 8, t. 1 (1784), Fl. Cap. 188 (1811) and ed. Schultes 45 (1823); non L. f. (1781).

Corm ovoid or subglobose, 2·5—3·5 cm. diam.; tunics of wiry dark reddish brown fibres, with a neck 6—12 cm. long. *Stem* simple, often curved just above the neck, 20—58 cm. high, usually 25—40 cm., 1·5—2 mm. diam. near the base. *Basal leaves* 5—9, with slender petioles, the blades linear-lanceolate, acuminate, 9—20 cm. long, 2·5—7 mm. wide, 2—3-nerved or occasionally 1-nerved; *cauline leaves* 2—3, the lowest brown, subulate, 2—5·5 cm. long, usually concealed by the basal leaves, the upper 1 or 2 varying from 1 cm. long to minute vestigial traces. *Spike* usually 3—5 cm. long, closely or fairly closely 7—20-flowered, occasionally 7—10 cm. long and somewhat lax. *Bract* and *bracteoles* firm, brownish, oblong or ovate, 5—9 mm. long, equal in length or the bracteoles slightly longer than bracts. *Flowers* zygomorphic, with a faint spicy scent, cream-coloured, usually with pale mauve or purplish marks towards the base of the 3 lower lobes; *perianth tube* 3—3·5 mm. long; *lobes* spathulate or the inner sometimes oblong-spathulate, all obtuse or slightly emarginate, 3—4·5 mm. wide near the apex, the claws canaliculate except in the dorsal lobe, the dorsal lobe 1—1·3 cm. long and others subequal, 0·9—1·1 cm. long, the 3 lower connate for 1·5—2 mm. *Stamens* arcuate; filaments 6—7 mm. long; anthers linear-sagittate, 4—5 mm. long, the apiculus acute, about 1 mm. long. *Ovary* ovoid, about 3 mm. long; style 9 mm. long, the branches cuneate, 1—1·5 mm. long. *Capsule* and seeds not seen.

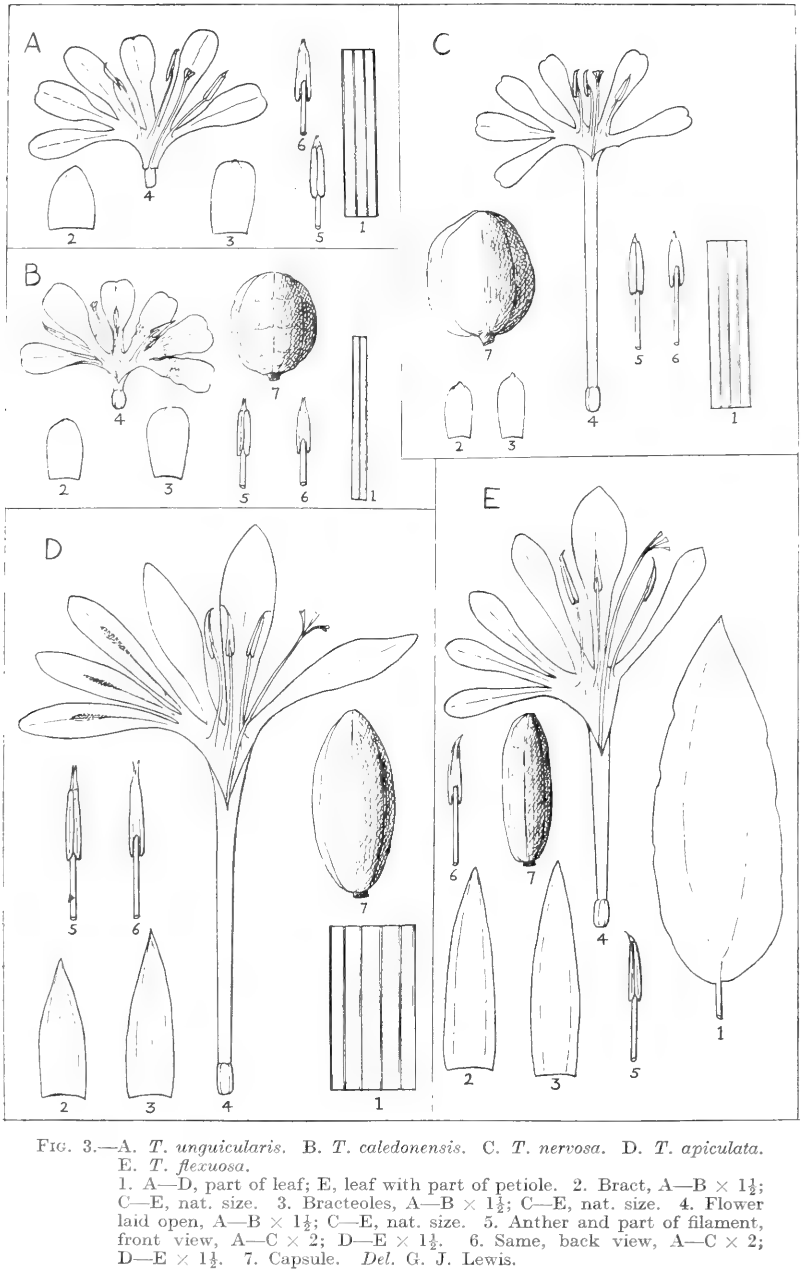

FIG. 3.—A. *T. unguicularis*. B. *T. caledonensis*. C. *T. nervosa*. D. *T. apiculata*. E. *T. flexuosa*.

1. A—D, part of leaf; E, leaf with part of petiole. 2. Bract, A—B × 1½; C—E, nat. size. 3. Bracteoles, A—B × 1½; C—E, nat. size. 4. Flower laid open, A—B × 1½; C—E, nat. size. 5. Anther and part of filament, front view, A—C × 2; D—E × 1½. 6. Same, back view, A—C × 2; D—E × 1½. 7. Capsule. *Del.* G. J. Lewis.

Mountain slopes and plateaux on the Cape Peninsula from Table Mt. to Chapmans Peak, in the Caledon Division from Steenbras to the Palmiet River and in the southern part of the Bredasdorp Division.

TYPE. *Sonnerat* in Herb. Lamarck, Natural History Museum Herbarium, Paris.

Flowering period. December—March.

CAPE. Top of Table Mt., *Zeyher* 1612 (SAM); *Bolus* 7426 (BOL, *s. n.* PRE); *Barker* 7212 (NBG); *Edwards* (No. 26633 in BOL, PRE); Table Mt., *Thunberg* (UPS, named *Gladiolus montanus*); *Lewis* 685 (SAM); *Prior* (K); *Burchell* 640 (type of *G. fraternus*, K, G); *Rodin* 3184 (BOL, K, PRE); *Kuntze* (K); *Gillett* 549 (K); *Drege* 8342 (G. K); *Dod* 2238 (or 2258) (BOL); Devils Peak, *Rehmann* 933 (BR); Nursery Gorge, Kirstenbosch, *Compton* 15494 (NBG); *Galpin* 12706 (PRE); top of Skeleton Gorge, *Esterhuysen* 11391 (BOL, PRE); Steenberg Plateau, *Lewis* 800 (SAM); *Salter* 2941 (BOL); near Ridge Peak, Muizenberg Mt., *Salter* 7971 (SAM); Muizenberg, *Penther* (PRE); mountains above St. James, *Moran* (PRE); mountains above Kalk Bay, *Bolus* 4002 (BOL, K); *Dod* 670 (K); Noordhoek Mt., *Jackson* (NBG).

CALEDON. Steenbras, *Salter* (No. 26635 in BOL); mountains N. of Steenbras River, *Salter* 4252 (BOL); Palmiet River Mts., *Stokoe* (No. 59833 in SAM); Oudebosch, *Stokoe* (No. 65596 in SAM); Palmiet River Valley, *Stokoe* 8837 (BOL).

BREDASDORP. Mountains near Elim, *Bolus* (No. 26634 in BOL).

WITHOUT LOCALITY. *Sonnerat* (named *Moraea unguicularis* in Herb. Lamarck); *Jussieu* 3651, partly (P); *Ecklon* 71 (1. 12), partly (G).

The locality for *Ecklon* 71 (1. 12) is "Worcester, beim Waterfall, 1,000—2,000 ft.", and the flowering month December, but it is very unlikely that this is correct for *T. unguicularis.* In the South African Museum Herbarium there are specimens of *T. parviflora* under *Ecklon* 71, and in the Herb. Delessert, Geneva, there are two specimens of *T. unguicularis* and one of *T. parviflora* on the same sheet under the same number, named *Hebea tabularis* Pers. The confusion between *T. unguicularis* and *T. parviflora* has been discussed in a note under the latter species.

11. **T. caledonensis** (Foster) Lewis comb. nov. (Fig. 3 B). *Exohebea caledonensis* Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 37 (1939).

Corm ovoid or subglobose, 2·5—3 cm. diam.; tunics of wiry dark reddish brown fibres, with a hard compact cylindrical neck 7—11 cm. long. *Stem* simple, usually curved just above the neck, 30—58 cm. high, usually 40—45 cm., 1·5—2 mm. diam. near the base. *Basal leaves* 3—7,

linear, 15—25 cm. long, 1—2 mm. wide, 1-nerved, not always fully developed at time of flowering; *cauline leaves* 2—3, the lowest brown, 2—3 cm. long, sometimes concealed by the basal leaves, the upper 1 or 2 much reduced and bract-like, 0·5—3 mm. long. *Spike* 3·5—10 cm. long, usually 7—8 cm. long and laxly 10—12-flowered, sometimes shorter, more compact and 6—10-flowered. *Bract* and *bracteoles* equal or the bracteoles slightly longer, oblong or ovate, obtuse, 4—7·5 mm. long, green at the base and brown above, coriaceous, firm. *Flowers* zygomorphic, with a faint musty scent, dull yellow, the 3 lower lobes sometimes with small purplish markings or a broad purple band near the middle; *perianth tube* 3 mm. long, slightly expanded at the throat; *lobes* undulate, emarginate, 3—4 mm. wide near the apex, the 3 upper more or less cuneate-spathulate and 3 lower cuneate-oblong, the latter with very short claws; dorsal lobe 0·9—1 cm. long; upper lateral lobes 8—9 mm. long, the claws canaliculate; 3 lower lobes alike, 8—9 mm. long, connate for 1·5—2 mm. *Stamens* arcuate; filaments 3—5 mm. long; anthers 3—4·5 mm. long, the apiculus obtuse or slightly bifid, 0·5—1 mm. long. *Ovary* ovoid or globose, 2·5 mm. long; style about 8 mm. long, the branches about 1 mm. long, cuneate. *Capsule* reddish brown, globose, inflated, about 1·5 cm. long; seeds up to 8 mm. long.

Rocky hill and mountain slopes in the Caledon Division.

TYPE. *Hafström* and *Lindeberg*, in Gray Herbarium, Harvard University.

Flowering period. November.

CALEDON. Near Caledon, *Hafström* and *Lindeberg* (GH); Honingklip, near Kleinmond, *Middelmann* (No. 69604 in SAM); hillside N. of Houwhoek Pass, 1,200 ft., *Galpin* 4726 (PRE); *Barker* 8810 (NBG); Houwhoek, *Maguire* 1242 a (NBG); Highlands, *Compton* 12282 (NBG); hill slope near Hawston, *Lewis* 5351 (NBG).

The specimens cited above have been compared with the type and although the flowers of the two plants on the type sheet are immature, there is no doubt at all that they are the same. The species is closely related to *T. unguicularis*, with similar small flowers, but differs in having fewer and narrower leaves which are always 1-nerved, and the flowers yellow instead of cream-coloured, with more undulate lobes, the 3 lower very shortly unguiculate and much wider in the lower half. The filaments and anthers are shorter than in *T. unguicularis*.

Some fruiting specimens from Michells Pass, Ceres Division, *Lewis* 5358, appear to be this species but this cannot be confirmed until the plants have been seen in flower.

12. **T. nervosa** (Baker) Lewis comb. nov. (Fig. 3 C). *Morphixia nervosa* Baker, Journ. Bot. (1876) 237; Journ. Linn. Soc. 16 : 98 (1877). *Ixia nervosa* Baker Handbk. Irid. 166 (1892); Fl. Cap. 6 : 85 (1896). *Tanaosolen nudus* N. E. Br., Trans. Roy. Soc. S. Afr. 20 : 262 (1932). *T. nervosus* (Baker) Lewis, Journ. S. Afr. Bot. 7 : 55 (1941).

Corm not seen, 12—15 cm. or more below ground, the neck (as far as seen) mostly hard, compact and cylindrical, 12—15 cm. or more long. *Stem* simple, usually curved just above the neck, 55—100 cm. high, 2—3·5 mm. diam. near the base. *Basal leaves* 5—6, distichous, linear-lanceolate, acuminate, 20—40 cm. long, 4—8 mm. wide, 2—3-nerved; *cauline leaves* 3—6, the lower 1—3 subulate or linear, 6·5—2 cm. long, the 1—3 upper minute and scale-like or up to 4 mm. long. *Spike* 10—25 cm. long, laxly 12—25-flowered. *Bract* and *bracteoles* firm, brown, oblong, subacute or acute, 5—9 mm. long, the bracteoles slightly longer than bracts. *Flowers* zygomorphic, scented, pale yellow or cream-coloured; *perianth tube* 3—4 cm. long, slender, straight or slightly curved near the throat, expanding gradually from 0·5—1 mm. diam. at the base to 1·5—2 mm. diam. at the throat; *lobes* subequal or the dorsal slightly longer than the others, 0·9—1·3 cm. long, 3—4 mm. wide near the apex, shortly unguiculate, the blade cuneate-oblong, obtuse or emarginate; 3 lower lobes connate for 1—2 mm. *Stamens* subarcuate; filaments 5—6 mm. long; anthers linear-sagittate, 4 mm. long, the apiculus obtuse, 0·5 mm. long. *Ovary* oblong, 2·5—4 mm. long; style 3·8—4·8 cm. long, the branches cuneate, 1—2 mm. long. *Capsule* reddish brown, inflated, ovoid or subglobose, about 2 cm. long.

In rock crevices on mountain slopes in the Clanwilliam, Piketberg and Ceres Divisions.

Type. *Zeyher* 1632 in Kew Herbarium.

Flowering period. December—January.

CLANWILLIAM. Algeria, Cedarberg, *Bond* 1320 (NBG); Pakhuis Mt., above 3,500 ft., *Leipoldt* 3581 (BOL, NBG, PRE); Pakhuis Pass, *Leipoldt* (No. 21508 in BOL, PRE); *Stokoe* (No. 55053 in SAM); Nieuwoudt Pass, *Esterhuysen* 7153 (BOL); *Salter* 5068 (BOL, SAM); hills 1 mile S.E. of Keerom, *Pillans* 8692 (BOL, SAM); western end of Elands Kloof, *Esterhuysen* 4159 (BOL, NBG, PRE); *Stokoe* (No. 55595 in SAM); without exact locality, *Mader* in Herb. Bolus 2175 (K); Keerom, W. slopes of Olifants River Mts., *Esterhuysen* 17917 (PRE).

PIKETBERG. Cardouw Mts., *Zeyher* 1632 (BOL, G, K, SAM); Porterville Mt., *Loubser* 421 (BOL).

CERES. Cold Bokkeveld, Tandfontein, 4,300 ft., *Schlechter* 10136 (type of *Tanaosolen nudus*, K, BOL, G, PRE); Skurfdebergen, *Primos*

(No. 45699 in SAM); *Marloth* 203 (PRE); de Straat, *Bond* 707 (NBG); Visgat, upper Olifants River Valley, *Esterhuysen* 13396 (BOL); eastern end of Elands Kloof, *Esterhuysen* 3961 (BOL); Elands Kloof, 3,000 ft., *Compton* 16791 (NBG); Onderboschkloof, upper Olifants River Valley, *Esterhuysen* 14288 (BOL, NBG, PRE); Cold Bokkeveld, *Adamson* D 39 (PRE).

This species is distinguished by its long slender perianth tube, about three times as long as the fairly small subregular lobes which closely resemble those of *T. unguicularis*.

13. **T. flexuosa** (L. f.) Lewis comb. nov. (Fig. 3 E). *Gladiolus flexuosus* L. f. Suppl. 96 (1781); Thunb. Diss. Glad. 9, t. 1 (1784), Prodr. 8 (1794). *Sphaerospora flexuosa* (L. f.) Klatt, Linnaea 32 : 726 (1863). *Acidanthera flexuosa* (L. f.) Baker, Berl. Monat. 19 : 15 (1876), Handbk. Irid. 186 (1892) and Fl. Cap. 6 : 131 (1896). *Exohebea flexuosa* (L. f.) Lewis, Ann. S. Afr. Mus. 40 : 4, t. 1 (1952).

Corm ovoid or subglobose, 1·5—2 cm. diam.; tunics matted, of brown or reddish brown wiry fibres, with a thick rope-like neck 9—15 cm. long. *Stem* fairly slender, simple, flexuose, 15—30 cm. high, 1—1·5 mm. diam. near the base. *Basal leaf* solitary, produced before the flowers, differentiated into a filiform petiole extending 2·5—5 cm. above ground and a distinct lamina rounded at the base and oblong or lanceolate-oblong, obtuse or acute, 3—5·5 cm. long, 1—2 cm. wide, 2-nerved, with more or less undulate margins; *cauline leaves* 4 or 5, brown at time of flowering, linear, acuminate, 4—7 cm. long, the lower half closely sheathing and partly amplexicaul, the upper part with firmly involute margins, appearing terete. *Spike* short, compact, 3—5-flowered. *Bract* and *bracteoles* light brown, firm, lanceolate, acuminate, 2·5—3·5 cm. long, equal or the bracteoles up to 5 mm. longer than bract. *Flowers* zygomorphic, pale salmon-pink, the 3 lower lobes with a crimson median line and sometimes also the 3 upper; *perianth tube* slender, straight or slightly curved, 3·4—3·8 cm. long, usually slightly expanded towards the throat; *lobes* oblanceolate, unguiculate, obtuse, subobtuse and minutely apiculate or subacute, the dorsal 2·5—3 cm. long, 5—8 mm. wide near the apex, the others subequal, 2—2·6 cm. long, 2·5—4 mm. wide, the 3 lower connate for 4—8 mm. *Stamens* subarcuate; filaments about 1·5 cm. long; anthers linear-sagittate, 7—8 mm. long, the apiculus acuminate, 1—2 mm. long. *Ovary* oblong, 3·5—4 mm. long; style 5—5·5 cm. long, the branches 3—4 mm. long, flattened, cuneate, sometimes retuse. *Capsule* reddish brown, ellipsoid, 1·5—2·2 cm. long, about 8 mm. in diam.; seeds about 5 mm. long, shortly winged.

Very local, in hard dry clay and stony soil on the lower northern slopes of Shaws Pass, Caledon Division.

TYPE. *Thunberg*, in Herb. Thunberg, Botanical Museum, Uppsala.

Flowering period. January—February.

CALEDON. Lower northern slopes of Shaws Pass, 5—5½ miles S. of Caledon, *Salter* 6853, 7222 (corms and basal leaves, BOL); *Lewis* 27 (corms and basal leaves, No. 52887 in SAM); *Lewis* 2243 (corms, fruits, immature leaves and flowers, No. 60708 in SAM); *Salter* 9032 (BOL); *Barker* 6102 (NBG).

WITHOUT LOCALITY. *Thunberg* (UPS, LINN).

The long bract and bracteoles and long-tubed flowers are similar to those of *T. apiculata*, to which this species is most nearly related, but the basal and cauline leaves are unlike those of any species in this genus though they somewhat resemble those of two species in the closely allied genus *Anapalina*. At the time of flowering there is no sign of the solitary basal leaf, with its clearly defined petiole and lamina; the specimens collected by Thunberg have no leaves or corm. A note on the rediscovery of this attractive and interesting species was published in 1952 in the Annals of the South African Museum (Vol. 40, p. 1).

14. **T. apiculata** (Bolus f.) Lewis comb. nov. (Fig. 3 D). *Gladiolus apiculatus* Bolus f., Ann. Bolus Herb. 2 : 106 (1917). *Hebea apiculata* (Bolus f.) L. Bolus, S. Afr. Gard. 19 : 123 (1929). *Exohebea apiculata* (Bolus f.) Foster, Contrib. Gray Herb., Harvard Univ., No. 127 : 36 (1939).

Corm subglobose, 3·5—6 cm. diam.; tunics thick, of coarse dark reddish brown fibres, the neck hard, compact and cylindrical, 12—18 cm. long. *Stem* simple (rarely with 1 or 2 short erect branches), rigid, straight or slightly flexuose, 25—40 cm. high, occasionally up to 50 cm., 2—3 mm. diam. near the base. *Basal leaves* 1—3, absent or sometimes 1 or 2 immature leaves present at time of flowering, usually fully developed 2 or 3 months later, the petiole slender and blade lanceolate or ensiform, acuminate, 15—32 cm. long, 0·5—2 cm. wide, 3—5-nerved (rarely 2); *cauline leaves* 4—5, green or brown at flowering time, subulate, 5·5—0·4 cm. long, the upper 1 or 2 much reduced and bract-like. *Spike* 2—16 cm. long, laxly or fairly closely 3—10-flowered, the flowers suberect. *Bract* and *bracteoles* reddish or reddish brown, somewhat membranous, soft or moderately firm, lanceolate, acute or acuminate, 2·5—5 cm. long (rarely 1·5—2·5 cm.), the bracteoles 1—9 mm. longer than bracts. *Flowers* zygomorphic, pale to fairly deep salmon-pink or pinkish mauve, the 3 lower lobes with a red or magenta median line on the lower half of the blade and claw; *perianth tube* straight or slightly curved, 4—7 cm. long,

gradually dilating upwards from about 1 mm. diam. at the base to 2·5—5 mm. diam. at the throat; *lobes* oblanceolate, obtuse or subacute, the dorsal 2·5—4 cm. long, 0·6—1 cm. wide, the others subequal, 1·8—3·5 cm. long, 4—8 mm. wide, the 3 lower connate for 4—8 mm. *Stamens* suberect or arcuate: filaments 1·5—2 cm. long: anthers linear-sagittate, 0·8—1 cm. long, the apiculus more or less recurved and bipartite, 1·5—2 mm. long. *Ovary* oblong, 4—5 mm. long: style 6·2—9 cm. long, the branches slender, 5—7 mm. long, cuneate at the apex or occasionally retuse or shortly bilobed. *Capsule* pinkish brown, ellipsoid or ovoid-ellipsoid, 2—3 cm. long: seeds up to 8 mm. long, usually broadly winged at the base and apex and shortly on the sides.

In sandy and stony ground on lower slopes of the Langeberg from Swellendam to Mossel Bay Divisions, and on the Swartberg in the Ladismith Division.

LECTOTYPE. *Muir* 2016 in the Bolus Herbarium.

Flowering period. March—May.

SWELLENDAM. Tradouw Pass, 1,700 ft., *Wurts* 589 (NBG); *Lewis* 5448 (NBG).

RIVERSDALE. N. slopes of Langeberg in Garcias Pass, *Esterhuysen* 16995 (BOL); S. slopes of Langeberg, Garcia Forest Station, *Esterhuysen* 17253 (BOL. PRE); Garcias Pass, c. 1,200 ft., *Smith* 2753 (PRE); *L. Bolus* (No. 26627 in BOL); *Lewis* 5382 (NBG); Riversdale, *Ferguson* (No. 20696 in BOL): *Muir* (No. 28677 in PRE).

MOSSEL BAY. Langeberg, *Muir* 1310 (BOL); Vrijersberg (= Vreyersberg), 1,500 ft., *Muir* 2016 (BOL): Berg Kloof, *Lewis* 5415 (NBG).

LADISMITH. Seven Weeks Poort, on S.W. spur, 4,000 ft., *Wurts* 1659 (NBG).

WITHOUT LOCALITY. *Muir* (No. 26626 in BOL).

Under *Gladiolus apiculatus* Bolus f. cited *Muir* 1310 and *Muir* 2016 and the latter, which is more complete, has been selected as the lectotype. The former number was given to two separate collections, a flowering shoot collected in April 1914 and two plants with corms, leaves and short stems bearing old capsules, dated June 1914. On comparing these two fruiting specimens with the large amount of material of *Tritoniopsis apiculata* now available it was found that they do not belong to this species, the following differences being noted: (1) The corms are smaller, with finer fibres and a shorter neck. (2) The leaves are narrower. (3) The stems are shorter than the leaves, only 10 and 12 cm. high. (4) The bracts are very much shorter, about 7—8 mm. long. (5) The capsules are shorter and more rounded, less than 2 cm. long. These specimens do not match

any species of Tritoniopsis which is known to occur in that area and might perhaps be young plants of *Anapalina revoluta* which does occur there.

Var. **minor** Lewis var. nov.

A var. *apiculata* bracteis brevioribus et tubo perianthii breviore, 2—2·8 cm. longo, quam segmento dorsali aequilongo vel leviter breviore, distinguitur.

Differs from var. *apiculata* in having shorter bracts and a shorter perianth tube, 2—2·8 cm. long, as long as the dorsal lobe or slightly shorter.

Southern slopes of the Swartberg, up to 3,500 ft.

Type. *Salter* 3126 in the Bolus Herbarium.

OUDTSHOORN. South slopes of Swartberg Pass, *Salter* 3126 (BOL); Swartberg Pass, 3,500 ft., *Compton* 10649 (NBG, BOL).

THE STEM ANATOMY OF RESTIO TRITICEUS ROTTB., BOBARTIA INDICA L., AND CADABA JUNCEA (SPARM.) HARV.

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The flora of South Africa contains a wealth of material worthy of the attention of the anatomist, yet the structure of very few species has been described in detail. The three species described in the present paper have little in common save that they all show xeromorphic features.

RESTIO TRITICEUS Rottb.

The anatomy of the Restionaceae has been treated on a comparative basis by Solereder and Meyer (1929), who also reviewed the results of earlier investigations in this family. There is, however, no readily accessible account in English of the detailed structure of any single named species.

Restio triticeus, a common member of the Western Cape heath community, exemplifies many of the anatomical peculiarities of the Restionaceae. This plant is low-growing, stiff and erect, with a tough, wiry stem. The internodes are long and the nodes are enclosed by brown scarious bracts.

The internal structure of the stem comprises three well defined zones: a thick epidermis, a palisade and an inner core of mechanical and conducting tissue. The general structure is shown diagrammatically in Fig. 1 and a more detailed drawing of the outer tissues is shown in Fig. 2.

The epidermis is made up of large cells, somewhat elongated radially. The outer walls are extremely thick and this thickening extends to a lesser degree down the radial walls. The thickening is accompanied by cutinisation but no lignification takes place. The outer surface of the epidermis is covered by a moderately thick cuticle. On the lower parts of the stem, near ground level, many of the epidermal cells form blunt protruberances, making the surface distinctly scabrid (Figs. 3 and 4). The cuticle and epidermis, even in the young plant, give a strong reaction for tannin.

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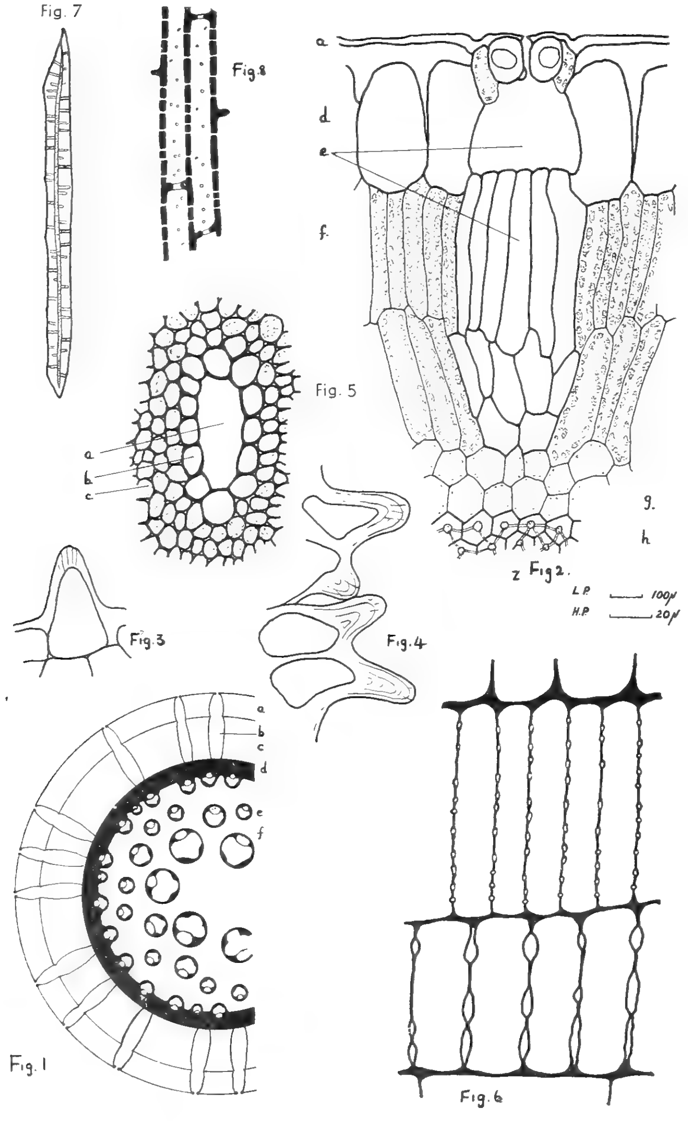


FIGS. 1—8.—The stem anatomy of *Restio triticeus*. 1. Diagram of the distribution of the tissues as seen in transverse section: a, epidermis; b, sub-stomatal cavity; c, palisade; d, sclerenchyma; e, vascular bundle; f, ground tissue. Fig. 2. Detailed drawing of part of the outer tissues of the stem: a, cuticle; b, guard cell; c, accessory cell; d, epidermis; e, sub-stomatal cavity; f, palisade; g, parenchyma; h, sclerenchyma. Figs. 3 and 4. Epidermal hairs from the lower part of the stem. Fig. 5. Tangential section through a sub-stomatal cavity at the level of the palisade: a, cavity; b, mechanical cells; c, palisade cells. Fig. 6. Wall structure of the palisade, as seen in transverse section. Fig. 7. Fibre from sclerenchyma sheath. Fig. 8. Thick-walled parenchyma of ground tissue, as seen in longitudinal section.

The surface of the stem is raised into minute mounds, on to each of which a stoma opens. The mouths of the stomata are orientated to lie across the long axis of the stem. Each is accompanied by two accessory cells which are parallel to and slightly shorter than the guard cells, that is the stomata are of the paracytic type. The guard cells have thick cutinised walls whereas the accessory cells are thin-walled and non-cutinised.

A characteristic feature of the genus *Restio* is the possession of long, cylindrical sub-stomatal cavities, extending radially inwards and traversing the palisade layer. These cavities are in two sections, the outer bounded by epidermal cells and the longer, inner section supported by special mechanical cells (Fig. 5). There is a slight constriction between these two regions. The mechanical cells occur in two or three series, those immediately beneath the epidermis being considerably elongated, whilst those seated deeper are shorter and somewhat irregular in shape. They are all empty cells with relatively thin walls, impregnated with cutin.

The palisade consists of two rows of radially elongated cells containing abundant discoid chloroplasts. The cells have thin cellulose walls with simple pits. They are densely filled with cytoplasm and have large nuclei. A strong tannin reaction is given by these cells, especially in the young stem. The outer rows of palisade cells are separated from each other by slight convolutions of the walls, which gives the walls between adjacent cells a beaded appearance. The inner cells have much larger and more irregular protuberances on the walls and are therefore more widely separated from each other (Fig. 6).

Within the palisade is a zone of parenchyma, one to three cells deep. These are living cells with nuclei and cytoplasm. They are somewhat elongated in the direction of the axis. The walls are fairly thick but unlignified. In young stems this zone is very conspicuous, consisting of a single row of large colourless cells which separate the palisade from the inner woody core.

A sheath of five to eight rows of sclerenchyma fibres form the main supporting tissue of the stem. These are closely packed cells, hexagonal in transverse section of varying length and with either blunt or pointed ends. The thick, lignified walls show conspicuous lamellations and are perforated by numerous pit canals (Fig. 7). These canals connect the narrow lumen of adjacent cells. In many cases these cells appear to have nuclei and cytoplasmic contents, the latter being continuous from cell to cell. In young stems this region is also a site of tannin accumulation.

The central part of the stem is occupied by numerous vascular bundles embedded in a more or less lignified ground tissue. The vascular bundles

are of the usual monocotyledonous type. There is a thin sheath of fibres, a strand of phloem, two large metaxylem vessels with tracheids between and a group of protoxylem vessels. The protoxylem vessels have annular thickening and occasionally give rise to lysigenous canals. A single series of small vascular bundles is embedded in the inner edge of the sclerenchyma zone whilst in the centre of the stem are twenty to forty scattered bundles of various sizes.

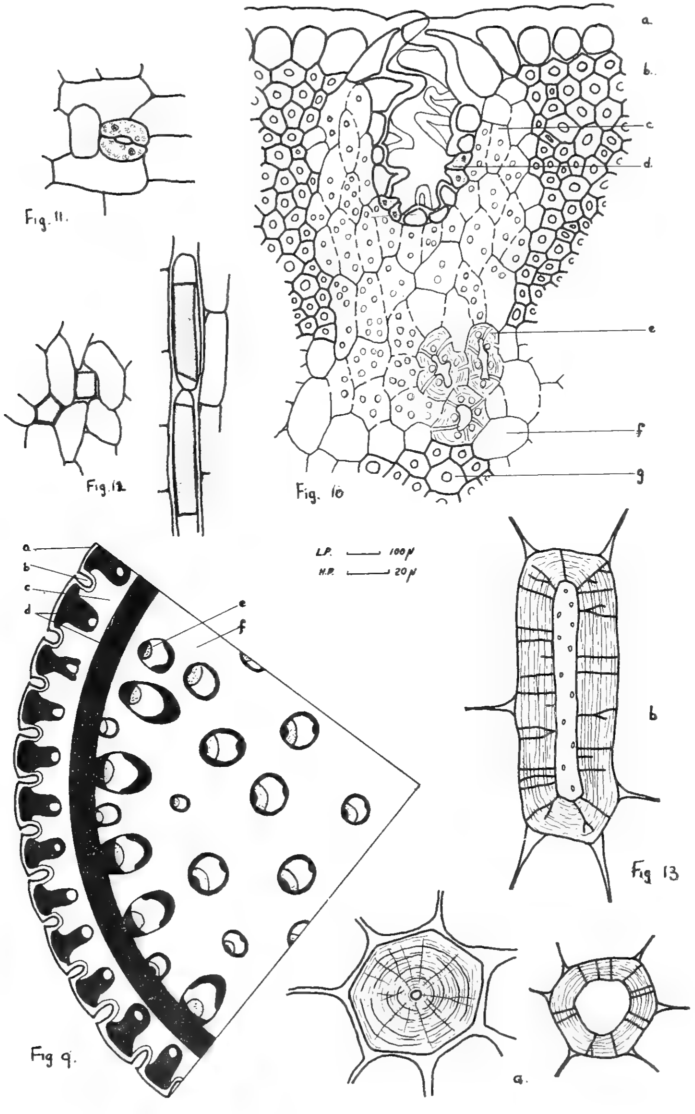
The ground tissue in which the vascular bundles are embedded consists of large, fairly thick-walled parenchyma cells (Fig. 8). These are living cells, highly vacuolated and containing starch. They are elongated in the direction of the axis and have transverse end walls. The innermost cells are the largest, being wider and shorter than the surrounding ones. Their walls are thin and have a tendency to break down and give rise to cavities in the centre of the stem. The peripheral cells, that is adjoining the sclerenchyma, may show some lignification, especially in the middle lamellae. The lignification is greatest in the lower parts of the stem, where the sclerenchyma and central vascular core form a single tough strand permeated by sclerotic cells.

BOBARTIA INDICA L.

Robartia indica has a short, swollen, branched woody rhizome from which arise tufts of stiff, rush-like leaves and flowering stems. The leaves are closely wrapped around the bases of the stems and in the upper parts are externally very similar to the stems. Inflorescences are borne near the apices of the stems and are surmounted by short, stiff spathes. It is the anatomy of the aerial stem which is described here. (See Figs. 9 and 10.)

The epidermis consists of large cells, the outer and radial walls of which are highly cutinised. Tannin may be detected in these cells but there is no lignification. The extremely thick cuticle gives a very strong fat reaction.

The surface of the stem shows fine longitudinal striations caused by the presence of stomatal furrows. These are lined by a continuation of the epidermis, the cells of which are thick-walled but smaller than those on the outer surface of the stem. They differ also in that many of them are prolonged into blunt hairs which project into the cavities of the furrows. Owing to the very thick, cuticularised walls the lumen of these cells is much reduced, forming a narrow tapering cavity at the distal end of each hair. The outer margins of the stomatal furrows are formed by particularly large epidermal cells which overarch the cavities.



FIGS. 9—13.—The stem anatomy of *Bobartia indica*. Fig. 9. Diagram of the distribution of the tissues as seen in transverse section: a, epidermis; b, stomatal furrow; c, chlorenchyma; d, sclerenchyma; e, vascular bundle; f, ground tissue. Fig. 10. Detailed drawing of part of the outer tissues of the stem: a, cuticle; b, sclerenchyma; c, chlorenchyma; d, guard cell; e, scleride; f, parenchyma; g, sclerenchyma. Fig. 11. Surface view of stoma and epidermal cells. Fig. 12. Transverse and longitudinal views of oxalate crystals in the chlorenchyma. Fig. 13. Sclerides from the ground tissue: a, transverse; b, longitudinal.

The stomata are situated at the bottom and sides of the furrows and are somewhat sunken below the level of the adjacent epidermal cells. The stomata are rather small and their mouths are orientated parallel to the long axes of the furrows and of the stem. The guard cells are thin walled and contain chloroplasts. Most of the stomata are anomocytic, but a few appear to have solitary accessory cells inclined at right angles to the pore (Fig. 11).

The tissue beneath and around the stomatal furrows consists of chlorenchyma. The cells are slightly elongated radially but do not form a definite palisade. They are thin-walled and have numerous circular perforations with raised borders. These chlorenchyma cells give a positive reaction for tannin. Irregularly distributed through the chlorenchyma are cells containing crystals of calcium oxalate. The crystals are square or pentagonal when seen in transverse sections but in longitudinal view appear as flat-ended prisms arranged in columns, running for considerable distances through the stem (Fig. 12).

Between the stomatal furrows are supporting ribs of sclerenchyma. This tissue is made up of fibres of varying diameter, with very thick lamellated walls traversed by fine pit canals. The lumen of the outer cells is very narrow, but that of the deeper ones is not so reduced. The sclerenchyma ribs at the base of the stem are wider than those in the upper parts. A small vascular bundle is situated at the inner edge of each of these ribs.

Internal to the chlorenchyma and sclerenchyma is an irregular zone of parenchyma and sclerotic cells, varying in width from two to five cells. The extent of lignification of this zone increases with age and is greatest where the stem leaves the protection of the basal tuft of leaves. Scattered amongst the parenchyma cells are brachysclerides, which although giving a weak lignin reaction, have thick lamellated walls. These sclerides are seen to be lobed in transverse section and the lumen follows internally the contour of the lobes. The walls are perforated by wide pit canals. The sclerides appear to develop by progressive lignification and thickening of chlorenchyma cells.

Bounding the inner vascularised core of the stem is a zone of sclerenchyma some ten cells deep. This is made up of fibres of the normal type, with simple pits with elliptical mouths. In the region of the stem just above the leaves, the thickest and toughest part, there may be an almost continuous system of lignified cells extending from the inner zone of sclerenchyma out to the sclerotic ribs underlying the epidermis.

The centre of the stem is occupied by vascular bundles embedded in a matrix of lignified parenchyma. The vascular bundles are arranged in

two series. One lies against the inner boundary of the sclerenchymatous sheath, consisting of both large and small diameter bundles. These bundles have conspicuous caps of sclerenchyma on their inner and outer edges and are somewhat elliptical when seen in transverse section. The second series of bundles is innermost. These are of intermediate diameter and are more or less circular in transverse section. They have a thick sclerenchyma sheath on all sides. The phloem is of the usual monocotyledonous type but the xylem does not show the typical arrangement. The metaxylem consists of vessels of various diameters, all fairly wide, but there are no tracheids present. In transverse section the smaller metaxylem vessels cannot be distinguished from the protoxylem. There are no protoxylem canals.

Parenchyma forms the ground tissue of the centre of the stem. These cells are at first filled with starch, but this is absent in the mature stem. The cell walls eventually become lignified and pitted. Some cells, scattered through the parenchyma, develop extremely thick walls, with almost complete elimination of the lumen, to form brachysclerides. These show numerous simple pits with long, narrow, often branched canals (Fig. 13).

CADABA JUNCEA (Sparm.) Harv.

Cadaba juncea is a broom-like plant which inhabits the more karroid regions of South Africa. The mature plant reaches two metres in height and is stiffly erect, with numerous pungent-tipped branches. There are two distinct types of shoots, the uppermost being pale glaucous-green, circular in section and tapering towards the apices. These become somewhat corky at their lower extremities. The branches at the base of the plant, either arising vertically or extending horizontally, are flattened and covered by a corky bark. In some cases these horizontal branches may form a stiff ribbon some eight centimetres across whilst being only one or two centimetres thick. There is a very abrupt boundary between these two branching systems.

The general structure of a young stem is illustrated by Fig. 14, whilst Fig. 15 shows the detailed structure of the cortex of a more mature stem. The upper green stems of the plant are covered by a very thick cuticle which gives a strong fat reaction. The epidermis is composed of radially elongated cells, the outer and radial walls of which are thick and heavily cuticularised. Thickening appears to take place centrifugally so that the cells develop lamellated caps in which the lumen becomes reduced to a narrow tube. However, the inner tangential wall remains thin and the

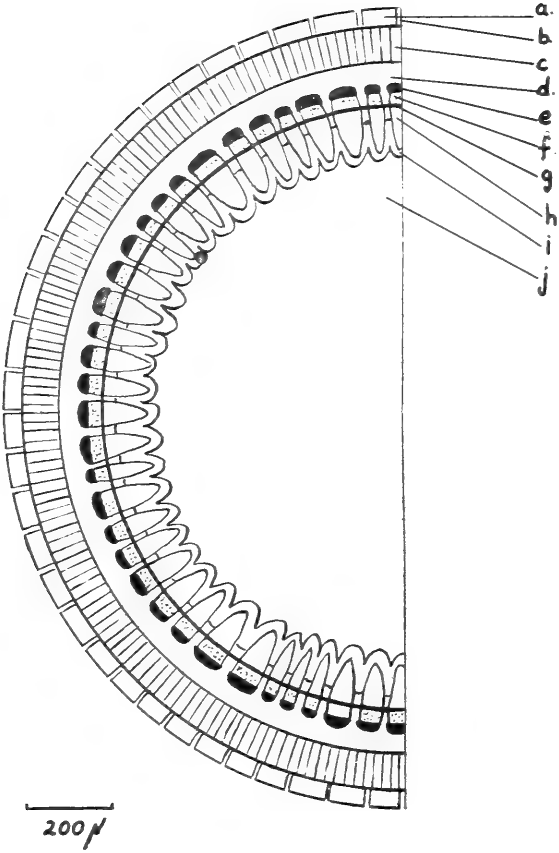


FIG. 14.—Diagrammatic representation of the distribution of the tissues in the stem of *Cadaba juncea*, as seen in transverse section: a, epidermis; b, stomatal pit; c, palisade; d, parenchyma; e, sclerenchyma; f, primary phloem; g, cambium; h, primary xylem; i, fibrous medullary sheath; j. medulla.

cells contain living cytoplasm and large nuclei. With the exception of the peduncles, which bear multicellular glandular hairs (Fig. 16), the epidermis is devoid of emergances.

The stomata are sunken in cylindrical pits, the guard cells lying at the level of the inner limit of the epidermis. The stomatal pits are frequently inhabited by colonies of a unicellular green alga closely re-

sembling *Chlorella.* The mouths of the stomata are orientated at right angles to the long axis of the stem. There are no accessory cells.

The cortex is differentiated into an outer palisade and an inner narrow zone of parenchyma. The palisade is about five cells deep. The cells are elongated radially, somewhat fusiform in shape and with thin walls. There are abundant chloroplasts and most of the cells contain cuboid crystals of calcium oxalate.

In the young stem there is a well-defined zone, about six cells deep, of starch-filled parenchyma underlying the palisade. At maturity this becomes differentiated into an outer region of lignified cells and an inner one of non-lignified cells containing oxalate crystals. Chloroplasts are present in all the cells in the young stem. No myrosin cells occur, as has been reported for some other genera in the Capparidaceae (Metcalfe and Chalk 1950).

The cortex of *Cadaba juncea* is the site of an unusual and interesting process of lignification. In the early stages, nodes of lignin develop on the facets of the isodiametric cells forming the inner parenchyma zone. From these a network of lignification spreads over the surfaces of the cells (Fig. 17). This is connected to and appears to be the point of commencement of the development of a lignified reticulum which permeates the palisade (Fig. 18). This takes the form of anastomosing lignified strands which pass out through the intercellular spaces, finally reaching the base of the epidermis. The strands are at first thin and weakly lignified. Increase in thickness and lignification of the strands proceeds centrifugally from the inner side of the palisade. The areas underlying the stomatal pits are at first unaffected but these, too, eventually become invested by the dense network of lignified strands (Fig. 15).

The stele is bounded by a series of lignified "pericycle" fibres which initially lie opposite the primary vascular bundles. As the stem matures these small irregular groups of fibres become laterally connected by brachysclerides which replace parenchyma cells.

The primary bundles are of the usual type for young dicotyledonous stems. There is a primary phloem within which is a broad cambial zone. There are numerous small xylem groups, each consisting of a single radial row of vessels embedded in fibres. The primary vascular rays are two to four cells wide, of fairly thick-walled, brick-shaped cells with numerous simple pits. The primary rays are persistent, being added to by cambial activity.

The medulla of the young stem consists of large, isodiametric parenchyma cells. At an early stage lignification sets in, although numerous small circular areas of the cell walls are left unthickened (Fig. 19). The

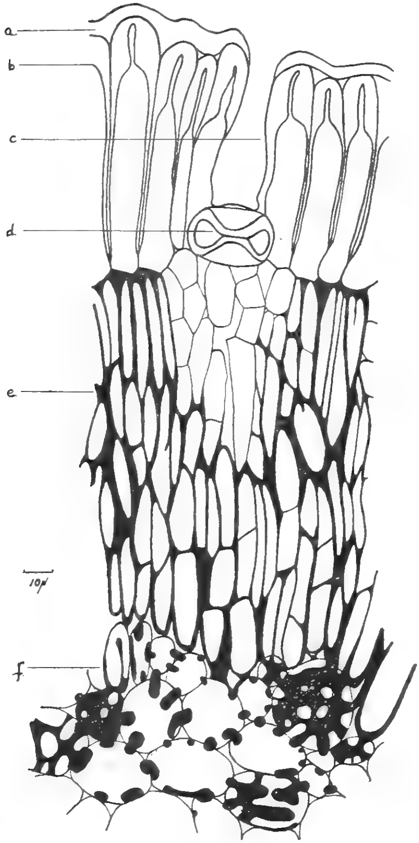


Fig. 15.—Detailed drawing of part of the outer tissues of the stem of *Cadaba juncea*, as seen in transverse section: a, cuticle; b, epidermis; c, stomatal pit; d, guard cell; e, palisade, showing extent of lignified strands; f, parenchyma, showing developing lignification.

cells in the vicinity of the protoxylem groups are the last to become lignified. In the final stages the entire medulla is occupied by cells having very thick walls, perforated only by simple pits (Fig. 20).

The primary stage of development is very short-lived. The structure and development of the secondary vascular cylinder is at first quite normal. Secondary phloem is formed centrifugally, causing distortion of

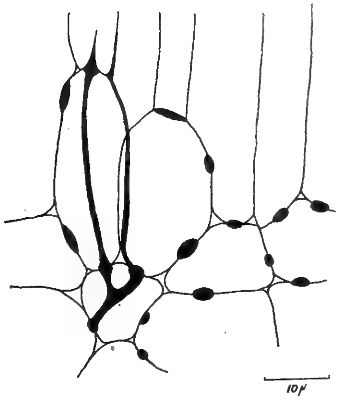


Fig. 17.

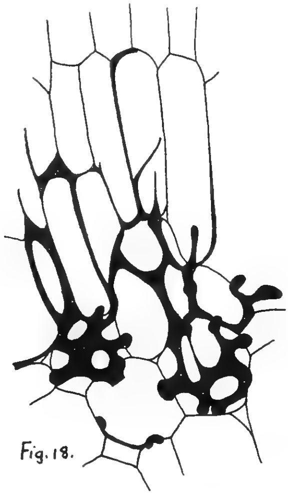


Fig. 18.

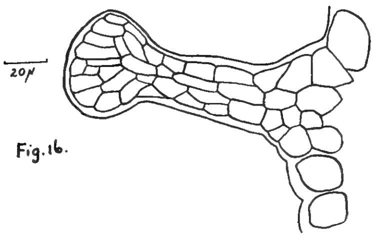


Fig. 16.

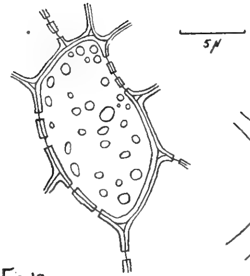


Fig. 19.

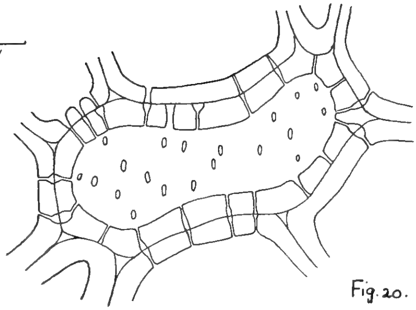


Fig. 20.

FIGS. 16—20.—The stem anatomy of *Cadaba juncea*. Fig. 16. Epidermal hair from peduncle. Figs. 17 and 18. Drawings of the inner part of the cortex as seen in transverse section, showing two early stages in the development of the lignified strands. Fig. 19. Parenchyma cell from medulla of young stem. Fig. 20. Highly thickened cell from medulla of mature stem.

the primary phloem. There are no secondary phloem fibres. The differentiation of the secondary xylem from the products of cambial activity proceeds rather slowly. The wood consists largely of fibres, interspersed with a small number of radial rows of vessels. The vessels are pitted, having very numerous small bordered pits with elliptical mouths (Fig. 21). This observation seems to be at variance with the statement by Metcalfe and Chalk (1950) that only simple pits occur. Though there is no raised annular border around the pit mouth, there is a large pit cavity and a conspicuous torus. In some specimens examined there were irregularly scattered tangential plates of parenchyma immersed in the wood.

When the stem reaches a diameter of about three millimetres the first phase of secondary growth ceases and anomalous development commences (cf. Adamson 1936, Metcalfe and Chalk 1950). Cambial activity is initiated in the region of the pericycle, in small patches which extend partially around the original woody cylinder (Fig. 22). Phloem is formed centrifugally and xylem centripetally. This causes considerable distortion of the underlying secondary phloem although in the early stages it hardly disturbs the outer tissues. As development proceeds, new wood is continually added to one side of the stem, the initially separate patches of cambium merging into an arc. Growth of a periderm accompanies expansion of the stele so that an unbroken secondary cortex is maintained. The new wood is rather more porous than the first-formed secondary xylem and the broad vascular rays often have a wavy appearance in transverse section.

Development of this pericyclic growth eventually ceases and cambial activity is renewed beyond the phloem. The new cambium now occupies a more restricted arc and the stem assumes a distinctly eccentric appearance. This process is repeated many times, new material being continually added to one side of the stem so that a broad woody ribbon is formed (Fig. 23).

Periderm formation commences just prior to the onset of pericyclic cambial activity and is seen as longitudinal corky fissures in the surface of the green stem. These become more numerous and extensive, anastomosing, and eventually, on the old main stem, covering the entire surface. The periderm is of epidermal origin (Fig. 24). Divisions commence in the inner half of certain epidermal cells, causing the accumulation of phellem within the lumen of these cells. As divisions proceed, the inner tangential walls of the epidermis are broken and displaced by phelloderm. Eventually the whole epidermis is lifted, the empty cuticularised walls curling outwards above the periderm. Periderm formation initially takes place in narrow sectors of the epidermis only, there being a very sharp boundary

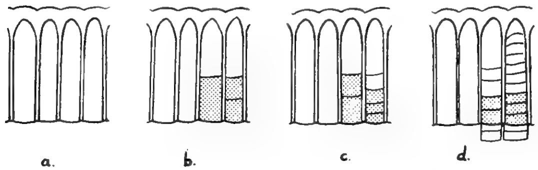


Fig. 24.

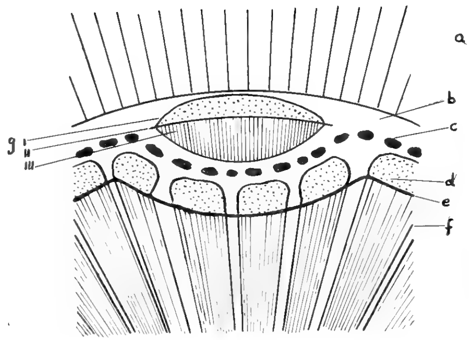


Fig. 22.

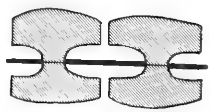


Fig. 21.

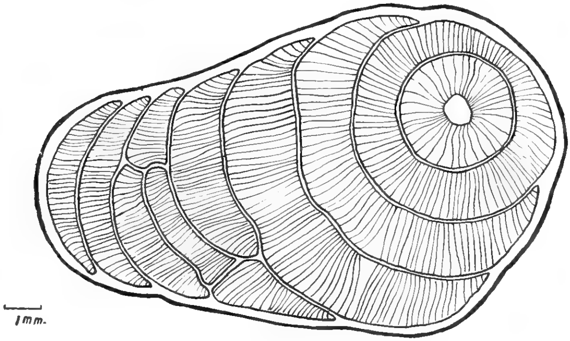


Fig. 23

FIGS. 21—24.—The stem anatomy of *Cadaba juncea*. Fig. 21. Diagrammatic longitudinal section through bordered pit of xylem vessel. Fig. 22. Diagrammatic representation of the initial stage of anomalous secondary thickening: a, palisade; b, pericyclic parenchyma; c, pericyclic fibres; d, secondary phloem; e, cambium; f, secondary xylem; g, anomalous secondary bundle: i, phloem; ii, cambium; iii, xylem. Fig. 23. Drawing of transverse section through mature stem. Fig. 24. Diagram to show the mode of periderm formation: a, normal epidermis; b and c, commencement of meristematic activity; d, establishment of phellem, phellogen and phelloderm.

between phellogen and undividing cells. The mature stem has a broad secondary cortex, due to phelloderm lying directly over the secondary phloem, although the phellem does not accumulate to any very great extent.

ACKNOWLEDGMENTS.

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NOTES ON MESEMBRYANTHEMUM AND ALLIED GENERA

By H. M. L. Bolus.

Aptenia lancifolia.—Planta 1 visa, herbacea glabra, minute nitente papillosa, laxe ramosa; rami primarii decumbentes teretes, saepe subflexuosi, ad 39 cm. longi, nodis interdum leviter constrictis, internodiis 1·5—4·5 cm. longis, 3—5 mm. diam.; folia opposita, ascendentia vel patentia, lanceolata vel anguste lanceolata, basim versus subpetiolata, obtusa vel subacuta, supra leviter canaliculata, obtuse carinata, viridia, fere ad 3·2 cm. longa, 6 mm. lata, culta per 3 menses ad 5·5 cm. longa, ad 1·2 cm. lata; flores solitarii vel rarius 3-nati tumque ramum terminantes, diurni, sessiles vel pedunculis 3—5 mm., fructiferis ad 7 mm., longis; receptaculum subclavatum, 4—5 mm. longum, ad 5 mm. diam.; sepala 2 exteriora superne leviter angustata, obtusa convexa, 5—6 mm., vel in flore majore ad 10 mm., longa, basi ad 4 mm. lata, 2 interiora e infra medium subulata, subula patente, 4—5 mm., vel ad 7 mm., longa, basi 1·5—2 mm. lata, omnia in fructu immaturo accrescentia; petala basi brevissime, vel vix ad 1 mm., coalita, 6-seriata, seriebus 3 exterioribus obtusa vel acuta, rosea, ad 9 mm. longa, ad 1 mm. lata, seriebus 3 interioribus pallidioribus, acuta vel acuminata, intima serie stamina circumdata eaque excedens, sed nulla staminodia antheras abortivas ferentia visa; filamenta alba, ad 3 mm. longa, antheris pollineque albis; nectarium non observatum; ovarii lobi levissime compressi, ca. 0·5 mm. elevati; stigmata gracilia, superne angustata, pallida, ad 2 mm. longa; capsula infra clavata, 4-angulata, inter angulos costata, 6 mm. longa, supra per 3 mm. elevata, suturis compressis, expansa ad 1·2 cm. diam., valvis 4 mm. longis, basi 4 mm. latis; semina eis **A. cordifoliae** simillima.

Transvaal: "on the farm Rouwput, near Bandolier Kop, Pietersburg district", May 1959, *A. W. Riley* (N.B.G. 372/59). Fl. Jun.—Jul. 1959.

Eberlanzia triticiformis (L. Bol.) L. Bol. var. **subglobosa.**—Folia subglobosa, 3—4 mm. longa, vel supra visa oblonga obtusa, ad 6 mm. longa, 3 mm. lata diametroque, omnia lat. visa apice rotundata; flores typo exacte similes, ad 1·9 cm. diam.; pedunculi saepissime 3, lateralibus 2—4 mm. longis, intermedio sterili spinescente, 6—8 mm. longo; capsula expansa, manu complanata, ad 1 cm. diam., valvis in parte superiore alam medianam membranaceam ferentibus, alis marginalibus nullis, carinis e basi late divergentibus, medium valvae attingentibus.

Cape Province: In dit. Oudtshoorn, "a few hundred yards S. of Warmbad in the Calitzdorp District", Jul. 1955, *A. M. du Plessis* (Bolus Herb. 26803); Stildrift, Jul. 1955, *R. du Plessis* 59.

The type of this species was described as *Mes. triticiforme* in 1925 from cultivated plants whose origin was unknown. These plants had no spines, but subsequent collections have been made showing the characteristic spines of **Eberlanzia** and the species was accordingly combined with this genus. After flowering the lateral peduncles are also spinescent.

Delosperma rileyi.—Planta 1 visa, per 2 menses culta, suffruticosa glabra gracilis, laxe copioseque ramosa, 20 cm. alta; rami erecti vel patentes vel subdecumbentes, pallide grisei, internodiis 1·5—3 cm. longis, vix ad 2 mm. diam., in ramulis multo brevioribus; folia ascendentia vel patentia, vel interdum demum falcate recurva, supra linearia, apicem versus leviter angustata, convexa, lat. visa abrupte acuta vel obtusa, lateribus convexis, novella carinata, carina in adultis nulla vel obscura, viridia polita, 1—2 cm., vel rarius ad 3·5 cm., longa, 2—4 mm. lata diametroque; flores solitarii diurni; pedunculi superne leviter ampliati, 4—10 mm. longi; receptaculum 1·5—2 mm. longum, ad 4 mm. diam.; sepala 5, valde inaequilonga, acuta vel acuminata, 3—10 mm., vel 3—7 mm., longa, basi 1·5—2 mm. lata, extima saepe patentia vel recurva; petala 3-seriata, inferne leviter angustata, obtusa, cuprea, interdum basim versus rosea, ad 8 mm. longa, vel senecta ad 10 mm., longa, 1—1·25 mm. lata; staminodia stamina conferta erecta aequantia vel exteriora ea bene excedentia; filamenta 3-seriata, alba, ad 4 mm. longa, intima prope medium papillata, antheris pollineque albidis; glandulae nectarii semilunatae; ovarium circa marginem concavum, lobis abrupte erectis, obtuse compressis, ad 0·75 mm. elevatis; stigmata 5, angustissime subulata, viridia, 2—2·5 mm. longa cum cauda 0·5 mm.

Transvaal: Sekukuniland, May, 1959, *A. W. Riley* (N.B.G. 368/59). Fl. Jun.—Jul. 1959.

Delosperma zoutpansbergense.—Planta 1 visa, per 3 menses culta, humilis glabra gracilis, diffuse ramosa, partes herbaceae virides, nitente papillosae; rami primarii decumbentes, ad 25 cm. longi, internodiis 1—4·5 cm. longis, saepius ad 1·5 mm. diam.; folia ascendentia vel erecta apicemque versus recurva, supra visa linearia, prope apicem leviter angustata, acuta vel subobtusa, dorso convexa, lat. visa obtusa, fere 1—3 cm., culta ad 5 cm., longa, medio 2—4 mm. lata diametroque, vagina in novellis 1·5 mm. longa; flores diurni, 2·7—3 cm. diam.; pedunculi saepe ad 1·5 cm. longi; receptaculum obconicum, 2—3 mm. longum, ad 4 mm. diam.; sepala 5, valde inaequilonga, acuminata, 2 exteriora 8—9

mm., vel in flore altero ad 10 mm., 3 interiora 4—5 mm. longa, basi 1·5—2 mm. lata; petala 2—3-seriata, parum inaequilonga, sat laxa, inferne leviter angustata, saepissime acuta, roseopurpurea, 1—1·3 cm. longa, 0·75—1·25 mm. lata; staminodia stamina conice conferta bene excedentia, exteriora late recurva, cum filamentis inferne rosea, superne alba; filamenta ad 3 mm. longa, interiora supra medium papillata, antheris pollineque albis; glandulae subdistantes crenulatae; ovarium concavum, medium versus sat abrupte elevatum ad 0·75 mm., lobis obtuse compressis; stigmata 5, anguste subulata, ad 3 mm. longa cum cauda 0·75 mm.; capsula non visa.

Transvaal: Zoutpansberg, "summit of Cloud End, above Mountain Inn", Dec., 1958, *A. O. D. Mogg* (N.B.G. 2/59). Fl. Apr.—May, 1959.

Delosperma lydenburgense L. Bol. var. **acutipetalum.**—Planta 1 visa per 2 menses culta, erecta glabra, diffuse ramosa, 20 cm. alta, partes herbaceae papillatae, papillis rotundatis; rami ascendentes 12—14 cm. longi, internodiis 1—5 cm. longis, ad 4 mm. diam.; folia ascendentia, supra visa e supra medium gradatim angustata, acuta vel obtusa, lat. visa prope apicem angustata, acuta vel obtusa, viridia, 3—7·5 cm. longa, medio 7—8 mm. lata; flores solitarii vel apice ramorum ternati vel irregulariter 2-ternati; pedunculi 1·4—2 cm. longi, in receptaculum obconicum, 4 mm. longum, ad 7 mm. diam., abeuntes; sepala 5, extima 2 acuminata vel obtusa, intima 2 late membranaceo marginata, e medio subulata, subula patente, 8—9 mm. longa, basi 3—4 mm. lata; petala 5-seriata, interiora pauca, inferne leviter angustata, saepius acuta, ad 3·3 cm. longa, 0·75—2 mm., saepius 1·5 mm., lata; staminodia pauca, stamina excedentia, superne recurva vel revoluta; filamenta erecta, pallide rosea, exteriora inferne ciliate papillata, interiora supra medium longe papillata, antheris pollineque albis; glandulae distantes, obscure crenulatae; stigmata 5—6, subulata, conspicue papillata, praecipue basim versus, 5·5 mm. longa cum cauda 0·75 mm.; capsula infra 4—5 mm. longa, obconica 5—6-angulata, inter angulos obscure costata, supra per 2 mm. elevata, suturis valde compressis, expansa 1—1·4 cm. diam., carinis prope apicem profunde laceratis; semina brunnea, minute tuberculata.

Transvaal: "On the farm Rouwput, near Bandolier Kop, Pietersburg district", May, 1959, *A. W. Riley* (N.B.G. 373/59). Fl. Jul.—Aug., 1959

Mr. Riley's discovery of this second species of **Aptenia** is noteworthy. It was found on his farm with 4 species of **Delosperma**—**D. tradescantioides, D. lydenburgense** var. **acutipetalum** and 2 species not yet identified. These might well have been expected to occur in that area. For **Delosperma** seems to be the only genus of *Mesembrieae* to reach the northern

limits of the Transvaal, and beyond them, being represented in Rhodesia by **D. mahoni** and **D. steytlerae** and farther north by **D. nakurense** and **D. abyscinicum.** But **Aptenia lanceolata** came as a great surprise 178 years after the first species, *M. cordifolium* L.f., was described in 1781, having been introduced to England by Masson in 1774 from the eastern coastal districts of the Cape Province. In 1925 it was distinguished from its allies by the absence of wings on the valves of the expanded fruit and became **Aptenia cordifolia** (L.f.) N.E.Br.—the name being derived from the Greek *apten*, wingless. This species has also been recorded from the Transvaal and probably does occur there spontaneously, although in some instances it may have been introduced and become naturalised, as has happened in other warmer parts of the world. Dr. Schwantes, who has made a special study of the fruit of the *Mesembrieae*, regards that of **Aptenia** as being quite the simplest form, in that the seeds are more readily shed than they are from the more complicated structures found in the other genera. These he describes as being among—"the most interesting and mysterious structures in the plant world and, in many ways the most beautiful".

(*To be continued.*)

A NEW STAPELIA FROM THE KAROO

By N. S. Pillans.

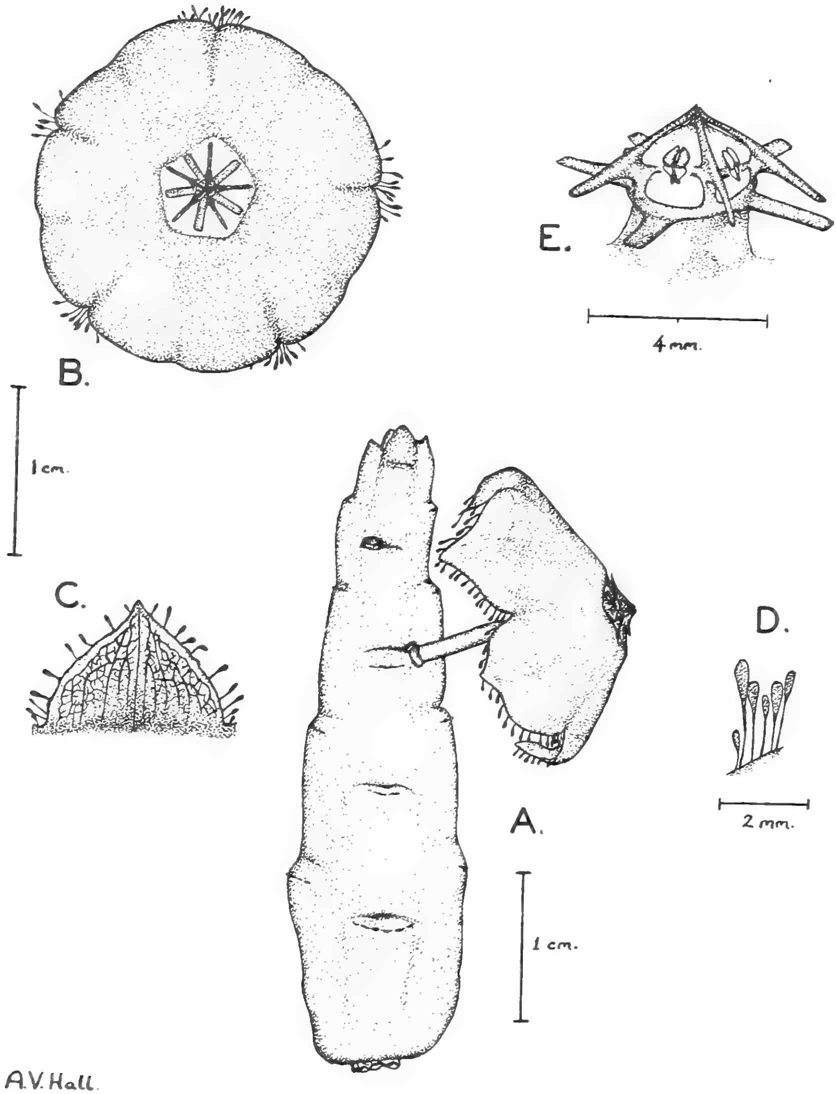
(*Bolus Herbarium, University of Cape Town.*)

Stapelia thudichumii Pillans, sp. nov. Caules ascendentes vel erecti fere 10 cm. longi, 4-angulati, minute papillati, dilute atropurpurea, dentibus minutissimis. Pedicelli fere 1 cm. longi glabri. Sepala 8—9 mm. longa, lanceolata. Corolla 1—3 cm. diam., fuscopurpurea. Discus 8 mm. diam., concavus, lobi deltoides clavato-ciliati. Coronae squamae exteriores oblongae obtusae fuscopurpureae; interiores erecta bipartitae.

Stems ascending or erect, about 10 cm. long, 1·5 cm. broad at the widest part, obtusely 4-angled, minutely papillate, mottled dull purple-brown, minutely dentate on the angles. Flowers solitary when developed. Pedicels about 1 cm. long. Sepals 8—9 mm. long, lanceolate, glabrous. Corolla 1·3 cm. broad, with a pentangular central depression 8 mm. wide and 2 mm. deep; disk convex, reticulately furrowed, purple-brown; lobes 0·9 cm. long, 1—1·1 cm. broad, deltoid, acute, much recurved with spreading margins on the lower half, pale purple-brown, with clavate vibratile cilia. Outer corona-lobes 2·5 mm. long, oblong, tapered to an obtuse apex, laterally compressed, glabrous, purple-brown; inner corona-lobes bicornate, purple-brown; dorsal horn 2 mm. long, linear-oblong, obtuse, widened at the base, laterally compressed; inner horn slightly shorter, subulate, obtuse, depressed at the base, somewhat recurved.

CAPE PROVINCE: Sutherland Div.: Tanqua Karoo, between Verlatenkloof and Granskraal, at locality known as Uitkomst. Collected by Mr. J. Thudichum, November, 1954. Type in Bolus Herbarium 26740, ex hort. Karoo Garden, Worcester, No. 583/54.

The affinity is with *S. revoluta* Mass. from which it is distinguished by the minute teeth and purple-brown mottling on the stems, the very much smaller papillate corolla, shorter, narrower, entire outer corona lobes and the outer segment of the inner corona neither clavate nor having tubercles at the apex.



Stapelia thudichumii.

FIGS. A, stem, pedicel and corolla; B, corolla, front view; C, corolla-lobe, dorsal surface; D, marginal hairs on the corolla; E, corona with anthers.

BOOK REVIEW.

TRACE ELEMENT PROBLEMS IN NATURE: A Symposium. Ed. by K. H. Schütte. Published by Bot. Dept., Univ. of Cape Town. 1959. 5s.

It is now generally recognised that a supply of certain elements such as iron, manganese, copper, zinc, cobalt, molybdenum, boron and iodine, in so-called trace quantities, is essential for the proper nutrition of both plants and animals. Lack of one or more trace elements may well have a most serious effect on the yields of agricultural crops or on the health of both animals and man. Diagnosis of trace element deficiencies is, however, a matter requiring specialist knowledge and without such diagnosis little can be done to remedy the existing position. From such little information as is at present available it would seem that some type of trace element deficiency is of widespread occurrence, both throughout Africa and in most other parts of the world. The diagnosis and subsequent rectification of trace element deficiencies is thus probably one of the most important problems facing organised agriculture to-day. The publication by the University of Cape Town of the proceedings of a symposium on "trace element problems in nature", held in the Botany Department in May, 1958, will accordingly serve a most valuable purpose in assisting in the wider dissemination of up-to-date scientific information on this subject.

In the first paper Dr. K. H. Schütte, of the Botany Department, University of Cape Town, gives a general review of the subject and indicates the complexity of the problems which need to be solved. These are immense, since a very wide range of factors may interact to produce conditions under which one or more essential trace elements become unavailable. To take one of the simplest and easiest cases first: the increasing use of chemically purer "artificial" fertilisers has often had the effect of cutting down the supply of trace elements which were formerly present as impurities. That these impurities may well have been of the greatest nutritional importance can be gauged from tea cultivation practices in Ceylon, where phosphate is normally supplied in the form of ground natural rock phosphate. When applied at the recommended rate, the impurities present in the natural rock phosphate have been found to be capable of supplying all the crop's requirements of zinc, copper and manganese, as well as half of its magnesium requirements.

Apart from difficulties arising out of variations in the availabilities of the different trace elements in the soil, there are also considerable

difficulties in correctly assessing the optimal requirements of different crops for particular elements. These difficulties arise from variations in the individual plant's rate of growth, and therefore requirements of a particular nutrient element, in response to seasonal, climatic and other environmental factors. Furthermore, sampling and analysis of only part of a plant, which in fruit farming may be a large tree, may often give an incorrect picture due to the mobility of some of these trace elements within the plant itself. Thus a small stunted plant may easily be suffering from a deficiency of a certain element and yet show a higher percentage content of that element than a larger more vigorously growing plant. However, the latter would almost certainly show a greater total content of the element concerned.

Similarly, different crops differ in their requirements of as well as in their abilities to obtain particular trace elements from different soils, so that one type of crop may grow well on a soil which will induce marked deficiency in another type of crop.

In the second paper Dr. S. S. Amdurer, of the Geology Department, University of Cape Town, discusses some of the factors affecting the occurrence and availability of trace elements in different soils. A point of great interest brought out in this paper is the marked similarity in both physical and chemical behaviour of the five important micro-nutrients: manganese, zinc, copper, cobalt and molybdenum. All these elements have ionic radii of similar magnitude and all have a strong affinity for sulphur, with which they readily form sulphides. Due to these similarities all five elements tend to have much the same type of distribution, with the consequence that cases of multiple deficiencies, in which more than one trace element is in short supply, may be expected to be of common occurrence.

The frequency with which cases of multiple deficiency are found in nature is a telling argument against undue reliance on the use of visual symptoms in the diagnosis of trace element deficiency in crops, since the symptoms developed are usually specific to the particular case. In any event they will almost certainly not correspond to the pictures of experimentally produced single element deficiencies normally made use of by the exponents of the method of visual diagnosis. However, the use of visual symptoms for diagnostic purposes is almost invariably a case of "shutting the stable door after the horse has been stolen", since, by the time marked visual symptoms have appeared, the plant is usually so short of the deficient element or elements that it is quite unable to produce any reasonable crop during that particular season even if prompt remedial action has been taken.

The much more elegant and valuable method of diagnosis by means of plant injection, developed by Dr. W. A. Roach, and which is described by him in the third paper, is free of these drawbacks and is therefore much to be preferred. With the introduction of his plant injection methods of diagnosis, Dr. Roach, who is a world authority on trace element problems, has undoubtedly made a great practical contribution towards helping the present-day agriculturist to both diagnose and remedy his deficiency troubles in time to prevent undue loss of crop. We are indeed fortunate that Dr. Roach is at present working with the Winter Rainfall Region of the Department of Agriculture at Stellenbosch, and it is to be hoped that South Africa will continue to be assured of Dr. Roach's specialist knowledge and wide experience for many years to come.

It would be presumptuous to comment on this most valuable contribution to the symposium. However, it should be noted that many of the South African deficiency cases investigated by Dr. Roach were found to be cases of complex multiple deficiencies of several trace elements, which would have proved difficult or impossible to diagnose correctly except by means of his plant injection technique.

The final paper, by Professor J. F. Brock, of the Department of Medicine, University of Cape Town, deals with the role played by trace elements in mammalian physiology and pathology. Of particular interest is his description of the recent research, which has successfully demonstrated the essentiality of selenium in the diet of experimental rats and chicks. The search for the particular factor required to eliminate the deficiency symptoms concerned was involved and difficult, since it was long and erroneously thought that the wanted factor was organic in nature as it was either lost or destroyed on dry ashing the protective diet. Boron, like selenium, is another trace element which is lost on dry ashing, and it is probably because of the analytical difficulties involved that even now still only comparatively little is known of the role of boron in plant and animal nutrition. It is to be hoped that this selenium work may stimulate further investigations into the functions and behaviour of boron.

As well as directly affecting nutrition, trace elements may also indirectly influence diet, since a deficiency or excess of certain trace elements may render a particular foodstuff unpalatable or otherwise unfit for consumption. Thus manganese-deficient potatoes, whilst apparently otherwise normal, may develop a most unpleasant flavour. Similarly, tea leaves containing less than about 15 p.p.m. of copper do not produce enough of their characteristic copper-containing polyphenol oxidase enzyme to permit of proper fermentation during the course of manufacture and are thus unsuitable for ordinary black tea production. This is

a curious case, since the enzyme concerned does not appear to play any major part in normal cell metabolism but is activated when the cell contents are brought into direct contact with atmospheric oxygen as a consequence of one of the processes of manufacture. In fact, tea clones with a natural copper content of under 10 p.p.m. are known which are vigorous growers and high yielders.

The letterpress and the numerous diagrams have been very clearly reproduced in photolitho-offset by the University of Cape Town Library and all concerned are to be congratulated on a most useful and acceptable publication.

G. B. PORTSMOUTH.

INDEX OF PLANT NAMES—VOL XXV, 1959.